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ABSTRACT

The Minnesota Science Education Task Force initiated a state-wide survey in 1983 to assess the current status of science education in Minnesota schools. This process involved instrument revision, sample design, data collection, file preparation and analysis. Questionnaires were modified to obtain information on the role of science teachers, the uses of instructional materials and strategies, and the extent of problem areas in science instruction in the various schools. Principals and teachers served as the data sources in the survey. This report is organized into major topic areas: (1) survey methodology; (2) science course offerings; (3) textbook and program use; (4) instructional techniques and activities; (5) facility, equipment, and supply status; (6) teacher and principal characteristics and qualifications; (7) information sources; (8) factors which affect instruction in science education; and (9) use of computers. In addition to the data that accompanies each chapter's findings, more detailed tabular results are provided in an appendix. Other appendices include a description of the reporting variables used in the analyses, explanation of the standard error computations, and copies of the survey instruments. (ML)

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REPORT OF THE 1983 MINNESOTA SURVEY OF SCIENCE EDUCATION

Minnesota Department of Education

February 1984

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CHAPTER 1

Introduction

CHAPTER 1

Introduction

A. Background and Purpose of the Study

The Minnesota Science Education Task Force defined the areas of interest for the Minnesota Survey of Science Education by listing the following questions:

1. What science courses are currently offered in schools?

2. What texts or curriculum programs are being used by elementary teachers, 7-9 Life Science Teachers, 7-9 Earth Science Teachers, 7-9 Physical Science Teachers, 10-12 Biology Teachers, 10-12 Chemistry Teachers, and 10-12 Physics Teachers?

3. What is the role of the science teacher in working with students? How has this role changed in the past five years? What commonalities exist in the teaching practices of science teachers throughout the state?

4. What is the status of science facilities, equipment, and supplies in Minnesota schools?

5. What are the characteristics and qualifications of science teachers? What areas do teachers feel in need of additional assistance?

6. What sources of information about what science topics to teach and how to teach science are commonly used by teachers?

7. What do teachers consider to be "problem areas" that affect the quality of science instruction in their schools?

8. How is the computer or microcomputer used in science instruction? What do teachers consider to be the "problem areas" that affect the use of computers in science instruction?

In March of 1983, the Minnesota Science Education Task Force contracted with Patricia Heller to design and implement a state-wide survey to answer those questions. Since the survey needed to be distributed before the end of the 1982-83 school year, the Task Force advised modification of the questionnaires from the 1977 National Survey of Science, Mathematics, and Social Studies Education[1]. Thus, the survey involved instrument revision, sample design, data collection, file preparation, and analysis. These activities are described in the following sections. The final section of this chapter outlines the content of the remainder of the report.

---

[1] Completed by Iris Weiss at the Center for Educational Research and Evaluation, Research Triangle Park, North Carolina for the National Science Foundation.

B. Instrument Revision

The Minnesota Science Education Task Force examined the principal and science teacher questionnaires from the 1977 National Survey. The Task Force recommended deletion of questions related to experience with federally-funded science curriculum materials and workshops, the use of different audio-visual materials, and the use of selected science equipment and materials. The Task Force also recommended the addition of several questions pertaining to issues of safety procedures and to the availability and use of computers in science teaching.

Preliminary versions of these additional questions and the remaining National Survey questions were reviewed by science education professors at the University of Minnesota and by three members of the Task Force. The questionnaires were revised based on the feedback from the reviewers. The final versions of the principal and teacher questionnaires were typed, printed, and ready for mailing by May 9, 1983. Copies of the questionnaires are included in Appendix D.

C. Sample Design

The Minnesota Survey of Science Education utilized a probability sample of districts, schools, and teachers. The sample was designed so that the state estimates of curriculum usage and classroom practices could be made from the sample data. The sample also ensured that estimates could be made for various subpopulations, such as teachers of a particular subject, or those teachers in a particular region or size of school district.

As in the 1977 National Survey, four grade ranges were chosen, K-3, 4-6, 7-9, and 10-12. The same number of teachers, 382, were sampled in each grade range. In addition, in grades 7-9, a third of the sample were teachers of life science, a third teachers of earth science, and a third teachers of physical science. Similarly, one third of the 10-12 sample were teachers of biology, a third teachers of chemistry, and a third teachers of physics.

The sample of teachers to be contacted in each grade range were selected using a multistage stratified cluster design. Figure 1 presents a brief diagram of the selection stages. First, school districts were stratified into the six strata of districts used in the Minnesota Assessment. These strata are described below.

Stratum 1 - Cities of the First Class: 12 percent of the public school students in Minnesota are enrolled in the Minneapolis, St. Paul, and Duluth school districts.

Stratum 2 - Seven-County Metro Suburbs: 37 percent of Minnesota students are enrolled in the seven-county metropolitan suburbs of the Twin Cities.

Stratum 3 - Districts larger than 2000 students: 22 percent of Minnesota students are in school districts outside the Twin Cities metropolitan area which enroll more than 2000 students.

Stratum 4 - Districts with 1000 to 1999 students: 12 percent of Minnesota students are in school districts outside the Twin Cities metropolitan area which enroll between 1000 and 1999 students.

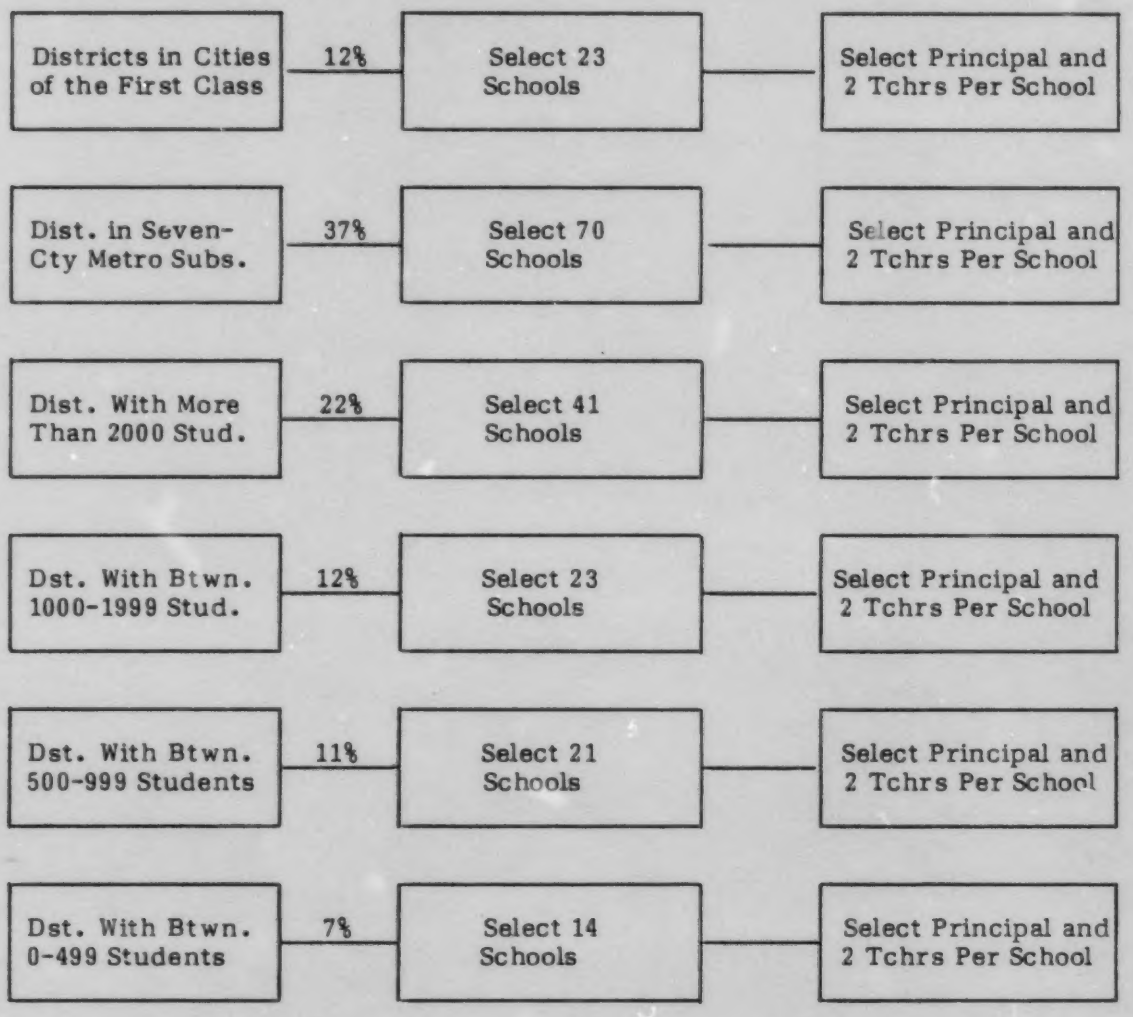
Stratum 5 - Districts with 500 to 999 students: 11 percent of Minnesota students are in school districts outside the Twin Cities metropolitan area which enroll between 500 and 999 students.

Stratum 6 - Districts smaller than 500 students: 7 percent of Minnesota students are in school districts outside the Twin Cities metropolitan area which enroll fewer than 500 students.

For each stratum, four lists of schools were completed for the four grade ranges, K-3, 4-6, 7-9, and 10-12. The schools were listed by size of student enrollment in the appropriate grade levels (a school was included in a grade range list if it included at least one of the grades in that grade range). For each list, school enrollment was accumulated and divided into six to eight equal sized parts. Within each of the parts, schools were randomly selected with a probability proportional to the school enrollment in that part.

Figure 1

Sample Design For Each Grade Range


Districts in Cities of the First Class
12%
Select 23 Schools
Select Principal and 2 Tchrs Per School
Dist. in Seven-Cty Metro Subs.
37%
Select 70 Schools
Select Principal and 2 Tchrs Per School
Dist. With More Than 2000 Stud.
22%
Select 41 Schools
Select Principal and 2 Tchrs Per School
Dst. With Btwn. 1000-1999 Stud.
12%
Select 23 Schools
Select Principal and 2 Tchrs Per School
Dst. With Btwn. 500-999 Students
11%
Select 21 Schools
Select Principal and 2 Tchrs Per School
Dst. With Btwn. 0-499 Students
7%
Select 14 Schools
Select Principal and 2 Tchrs Per School

Prior to sample selection of teachers, all teachers in the K-3 and 4-6 grade ranges were listed for each sample school. Two teachers were randomly selected from each school. This method assured that the sample of teachers was distributed among the eligible grades in approximately the same proportion as the population of teachers is distributed by grade.

Science teachers in all sample schools in the 7-9 and 10-12 grade ranges were listed with the subjects taught (life science, earth science, and/or physical science for grades 7-9 and biology, chemistry, and/or physics for grades 10-12). One third of the teachers in each grade range were randomly selected in each of the three subject areas, with the condition that no more than two teachers were selected per school.

D. Data Collection

On May 9, 1983, a form letter and questionnaire were sent to the 1530 sample teachers and 486 sample principals. One week after the initial mailout, a "thank you/reminder" letter was sent to all sample teachers and principals. The final response rate for each grade range is shown in Table 1. The response ranged from 44 percent for elementary teachers to 76 percent for secondary principals.

Table 1

Survey Response Rates

Type of Respondent	Number of Questionnaires Sent Out	Number of Questionnaires Received	Response Rate
K-6 Teachers	768	340	44%
7-12 Teachers	762	464	61%
K-6 Principals	328	216	66%
7-12 Principals	353	270	76%

E. File Preparation and Analysis

Manual editing was used to identify and, if possible, resolve multiple responses. For example, if a teacher indicated that 50-60 minutes were typically spent on mathematics instruction, the average value of 55 minutes would be used. Non-numeric open-ended responses were also coded at this time. For example, a list of natural science areas was used to code all questions where natural science college majors or minors were requested.

Following manual coding and editing, the questionnaire data were entered onto data tapes and read at the University of Minnesota computer center. A number of computer data checks were carried out. Responses which were outside the acceptable range for each item were coded as "bad data"; for example, if a teacher indicated that she had taken her last course for college credit in 1985, this response was considered uncodable. Similarly, if the number of minutes per day reportedly spent on teaching science exceeded the number of minutes in the school day, the response was considered uncodable.

The majority of the computer data checks involved routing. A routing question is one that either implicitly or explicitly directs a respondent around other questions in the instrument. The aim of the routing questions is to quickly move respondents around questionnaire sections that do not apply to them. Responses which did not correctly follow the routing pattern were coded as "inconsistent data." For example, if a principal indicated that no federally-funded curricula were used in his/her school, and then proceeded to fill in the code numbers of the federally-funded curricula used in the school, the data are clearly inconsistent; in these cases the data were omitted from the analysis.

All data in this report are actual percentages (unweighted) calculated for the sample. The data were not adjusted (weighted) for sampling bias or corrected for a non-response bias. Therefore, care should be taken in interpreting the data.

F. Sampling Error Considerations

The results of any survey based on a sample of a population (rather than on the entire population) are subject to sampling variability. The sampling error (or standard error) provides a measure of the range within which a sample estimate can be expected to fill a certain proportion of the time. For example, it may be estimated that 13 percent of all K-3 teachers are not using a published textbook or program. If it is calculated that the sampling error is 3 percent, then according to the Central Limit Theorem, 95 percent of all possible samples of that same size selected in the same way would yield no textbook/program usage estimates between 7 percent and 19 percent (that is, 13 percent ± 2 standard error units).

The decision to obtain information from a sample rather than from the entire population is made in the interest of reducing costs, both in terms of money and the burden of the population to be surveyed. The particular sample design chosen is the one which is expected to yield the most accurate teacher data for the least cost.

In general, this report points out only those differences which are substantial as well as statistically significant at the 0.05 level or beyond. The reader who wishes to determine if particular percentages shown in the tables differ significantly should refer to Appendix C for instructions for using the Generalized Table of Standard Errors. This table is based on a simple random sample design rather than the stratified cluster design used in this survey. Therefore, the standard errors reported on this table may be an underestimate of the actual sampling errors.

G. Outline of This Report

This report of the 1983 Minnesota Survey of Science Education is organized into major topical areas. Data from the two sources -- principals and teachers -- are presented as appropriate throughout the report.

Chapter 2 presents information about science course offerings. The percent of secondary schools offering common courses is presented. Information about course duration, average class size, and percent of female students is also presented.

Issues related to textbook usage are examined in Chapter 3. The most commonly used textbook in each subject/grade range category (K-6, 7-9 Life, Earth, and Physical Science, and 10-12 Biology, Chemistry, and Physics) are listed, and data are presented about use of multiple texts and the age of textbooks being used. School and teacher use of selected federally funded curriculum materials are considered as well as principals' perception about the textbook/program selection process.

Chapter 4 compares the frequency of use of various instructional techniques and classroom activities in science in each of the four grade ranges. Chapter 5 presents a variety of data about science facilities, equipment, and supplies. Topics include school expenditures, the availability and use of selected facilities, equipment, and supplies, and teacher ratings of the adequacy of facilities, equipment, and supplies.

The qualifications of principals and science teachers are discussed in Chapter 6. Data about teacher characteristics such as sex, undergraduate and graduate science majors, and teaching experience are presented. However, the major focus of the chapter is on areas in which teachers feel the need for additional assistance.

Chapter 7 deals with the sources of information used by principals to find out about new developments in education and the sources of information used by teachers to find out what topics to teach in science and how to teach science. Specific sources which are discussed include several categories of state and local district personnel, a number of types of professional activities, and professional publications.

Chapter 8 presents data about perceived "barriers" to science instruction. Responses of principals and teachers about the seriousness of different potential problems are compared.

Finally, Chapter 9 deals with a variety of topics related to the availability and use of computers in science instruction. Topics include number and frequency of use of computers, sources of science computer software, purpose of and types of computer activities used in instruction, and perceived "barriers" to the use of computers in science instruction.

To improve the readability of this report, many of the more detailed tabular results have been placed in Appendix B. In addition, the appendices include a description of the reporting variables used in the analyses, and explanation of the standard error computations, and copies of the survey instruments.

CHAPTER 2

Science Course Offerings

A. Overview

Elementary teachers provided data about the time spent in science, as well as mathematics, social studies, and reading/language arts instruction; these data are reported in Section B. Principals of schools with grades 7-12 were asked to indicate the number of sections and total enrollment of each science course offered in their schools. These data were used to calculate the percent of schools offering each course; the result of this analysis is presented in section C. Finally, Section D presents some miscellaneous information about science classes, including course duration and average class size for each sample subject.

B. Time Spent in Science Instruction in Grades K-6

Each elementary teacher was asked to write in the approximate number of minutes per week typically spent teaching mathematics, science, social studies, and reading/language arts[1]. In addition, they were asked to write in the number of minutes they considered would be ideal for their students to receive instruction in each subject area. The average number of minutes per day typically spent in K-3 and 4-6 instruction, and the ideal average number of minutes per day in each subject are shown in Tables 2 and 3, respectively.

In each grade level the amount of time spent is greatest for reading/language arts, followed by mathematics, then social studies and finally science. However, the difference between reading/language arts and the other subjects decreases from K-3 to 4-6 because the amount of time spent on reading/language arts decreases and the amount of time spent on each of the other subjects increases. Minnesota averages are the same as the national (1977) averages.

A comparison of Tables 2 and 3 indicates that elementary teachers feel they are spending the appropriate amount of time teaching reading/language arts and mathematics. However, they would ideally like to spend between [illegible] and 10 minutes more per day teaching science, and 5 minutes more per day teaching social studies.

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[1] The reader should exercise caution in interpreting these results since they are based on teacher estimates of time spent rather than on precise measurements.

Table 2

Average Number of Minutes Per Day Spent
By Elementary Teachers Teaching Each Subject
In Self-Contained Classes, By Grade Range*

Subject	GRADE RANGE K-3 Average No. of Minutes	K-3 Standard Error	GRADE RANGE 4-6 Average No. of Minutes	4-6 Standard Error	K-6 Total Average No. of Minutes	K-6 Total Standard Error
Mathematics	38 (41)+	0.98	51 (51)	1.13	45 (44)	0.84
Science	17 (17)	0.72	26 (28)	0.87	22 (20)	0.63
Social Studies	19 (21)	0.85	35 (34)	1.37	28 (25)	0.96
Reading and Language Arts	128 (95)**	9.29	90 (66)	2.13	109 (86)	4.77
Sample N	134		141		275	

* Only teachers who indicated that they teach mathematics, science, social studies, and reading to one class of students were included in this analysis.

\+ Results of 1977 national survey in parentheses.

** 1977 National results for Reading only.

Table 3

Average Number of Minutes Per Day Considered Ideal
By Elementary Teachers To Spend Teaching Each Subject
In Self-Contained Classes, By Grade Range*

Subject	GRADE RANGE K-3 Average No. of Minutes	K-3 Standard Error	4-6 Average No. of Minutes	4-6 Standard Error	K-6 Total Average No. of Minutes	K-6 Total Standard Error
Mathematics	41	1.17	55	1.25	48	0.86
Science	24	1.00	36	1.37	30	0.84
Social Studies	24	0.99	40	1.37	32	0.83
Reading and Language Arts	128	10.96	90	2.41	109	4.74
Sample N	109		108		217	

* Only teachers who indicated that they teach mathematics, science, social studies, and reading to one class of students were included in this analysis.

Each K-3 and 4-6 teacher was asked how the amount of time spent in science instruction compared to the amount of time spent in a similar class 3 years ago. The responses of all teachers who taught a comparable class 3 years ago are shown in Table 4. Approximately 60 percent of the teachers spend the same amount of time on science instruction as was spent 3 years ago. The percent spending more time now was roughly the same as the percent spending less time now (16 and 15 percent, respectively). These results are the same as the 1977 national survey results.

C. Science Course Offerings in grades 7-12

Each 7-12 principal was given a list of science courses and asked to specify the current total enrollment and the number of sections of each course offered in the school. Table 5 shows the percent of schools in each grade range which offer each of the most common science courses. To help in the interpretation of results, data are presented for 5 groups:

1. schools which include one or more of the grades 7-9 but do not include any higher grades (typically junior high schools and middle schools);

2. all schools which contain one or more of the grades 7-9 (includes K-12, 7-12, 9-12 schools):
3. schools which include one or more of the grades 10-12 but do not include any of the lower grades;
4. all schools which contain one or more of the grades 10-12 (includes K-12, 7-12, 9-12 schools); and
5. all schools which contain one or more of the grades 7-9 and also one or more of the higher grades (typically K-12, 7-12 and 9-12 schools).

Table 4

Percent of Elementary Teachers Spending More Time, The Same Amount of Time, and Less Time on Science Compared To Three Years Ago, By Grade Range*

Amount of Time	K-3	4-6	K-6 Total
More Time Spent Now	19 (22)+	13 (10)	16 (17)
About the Same	61 (52)	64 (72)	63 (60)
Less Time Spent Now	12 (14)	18 (13)	15 (14)
Missing	8 (12)	4 (5)	6 (9)
Sample N	143	159	302

* Teachers who indicated they did not teach a class of the same grade level three years ago were not included in this analysis.

+ Results of 1977 national survey in ( ).

There is some evidence in the table that a few principals may have made incorrect entries in their questionnaires. For example, according to Table 5, 5 percent of the "schools with only grades 7-9" offer a course in Biology I, which is normally a 10th grade course. This type of error does not, however, appear to have been widespread. A potentially more serious error is that some principals may not have followed the instruction, "do not include courses or enrollments more than once." This problem is more likely to have affected 7-9 courses than 10-12 courses, since high school courses tend to have specific titles.

Some of these data are based on extremely small samples. For example, of the 586 7-12 sample schools, only 75 schools are in the "schools with only grades 7-9" category, while only 21 are in the "schools with only grades 10-12" category.

Even with these limitations, patterns of science course offerings can be seen. Earth and Life Science courses are offered at over 60 percent of schools with only grades 7-9. About 45 percent of the schools with grades 7-9 offer the Life Science, Earth Science, and Physical Science sequence, while about 38 percent offer the General Science sequence. At the high school level, the most commonly offered science courses are biology, chemistry, and physics. Schools which contain grades 10-12 only are significantly more likely to offer advanced science courses, such as Biology II and Chemistry II, than schools which also contain one or more of the lower grades.

Principals were also asked if any science course offerings had been added or deleted at their schools in the last 3-5 years. Thirty-five percent of the secondary schools have added at least one science course offering, while only 14 percent have deleted one or more science course offerings. The most frequently added courses were advanced biology (4%), human anatomy, and/or physiology (6%), environmental/ecology (9%), and astronomy/aerospace (7%). Similarly most of the deleted courses were advanced or special topic courses.

Table 5

Percent of Schools Offering Each of the Most Common Science Courses by Grade Range

	Percent of Schools Offering Course				
Science Courses	Schools w/only Grades 7-9	All Schools with Grades 7-9	Schools w/only Grades 10-12	All Schools with Grades 10-12	Schools with Grades 7-12
General Science, Grade 7	39	37	0	32	37
General Science, Grade 8	37	37	0	32	36
General Science, Grade 9	16	41	0	46	52
General Science, Grades 10-12	0	7	10	11	11
Earth Science	60	44	5	33	37
Life Science	63	46	0	33	37
Physical Science	38	46	10	43	47
Biology I	5	65	86	92	93
Chemistry I	1	58	100	87	85
Physics	0	58	95	87	86
Biology II	0	22	62	35	32
Chemistry II	0	11	24	17	16
Sample N	75	233	21	179	158

D. Other Characteristics of Science Classes

Table 6 shows the percent of 7-9 and 10-12 science courses which are full year, semester, and quarter courses. Only 54 percent of the 7-9 classes are one year in length, compared to 83 percent of the 10-12 classes, most of the remainder are semester courses. The 7-9 data differ significantly from the 1977 national results. This could be due to the fact that Minnesota requires only 240 hours of Junior High science instead of the usual 360 hours.

Table 6

Percent of Secondary Courses of Varying Durations, By Grade Range

Duration	7-9	10-12	7-12 Total
Year	54 (86)+	83 (88)	68 (87)
Semester	28 (7)	10 (6)	20 (6)
Quarter	5 (4)	2 (4)	3 (4)
Missing	14 (2)	6 (3)	10 (3)
Sample N		242	222 464

+ Results of 1977 national survey in ( ).

Table 7 shows the average science class size by science subject and grade range. Class size by sample strata and grade range are shown in Appendix, Table B.1. K-3 and 10-12 classes are significantly smaller than those in 4-6 and 7-9. K-3 and 10-12 class sizes are larger than the 1977 national survey averages (by about 1 student), whereas 4-6 and 7-9 class sizes are smaller (by 0.7 and 3.6 students) respectively. There are no significant differences in class size within grade ranges by science subjects taught. In general, school districts with less than 2000 students have smaller class sizes than districts in Cities of the First Class, the seven-county metro suburbs, or districts with more than 2000 students (by between 2.5 and 5.5 students).

Table 7

Average Class Size By Grade Range And Subject

Grade Range	Sample N	Avg. No. of Students Per Class	Range	Standard Error
K-3	151	24.5 (23.5)+	13-34	.34
4-6	172	25.9 (26.6)	14-35	.33
7-9 Life	62	26.7	11-37	.60
7-9 Earth	73	27.6	15-38	.5[illegible]
7-9 Physical	67	26.5	13-41	.60
7-9 Total	202	27.0 (30.6)	11-41	.33
10-12 Biology	76	23.3	15-36	.48
10-12 Chemistry	62	23.4	10-32	.63
10-12 Physics	60	20.2	2-36	1.00
10-12 Total	198	23.5 (22.8)	2-36	.44
K-12 Total	723	25.3 (25.9)	2-41	.19

+ Results of 1977 national survey in ( ).

Table 8 shows the percent of female students in secondary science classes. As expected, about 50 percent of the students in required 7-9 science classes and in 10-12 Biology are female. The results for 10-12 Chemistry and Physics are encouraging; 49 percent of the students in Chemistry classes and 38 percent in physics classes are female.

Table 8

Percent of Female Students in Secondary Science Classes, By Subject

Subject	Sample N	Average Percent of Females	Standard Error
7-9 Life Science	60	48.1	1.21
7-9 Earth Science	67	48.6	1.04
7-9 Physical Science	61	50.7	1.17
7-9 Total	188	49.1	0.65
10-12 Biology	74	50.2	1.37
10-12 Chemistry	59	48.6	1.59
10-12 Physics	59	38.3	2.32
10-12 Total	192	46.1	1.07
7-12 Total	380	47.6	0.63

CHAPTER 3

Use Of Textbooks/Programs In Science Classes

A. Overview

Each teacher was asked if he or she was using one or more published textbooks or programs in a randomly selected science class. Those who indicated they were using these materials were then requested to answer a series of questions about the textbooks or programs used in this class.

Principals were asked if their schools were using any of the federally funded (NSF) science curriculum materials. They were also asked about the involvement of various individuals and groups in selecting the textbooks to be used.

B. Textbook Usage

Each teacher who indicated that one or more textbooks/programs were used in a selected class was asked to specify frequency of use of the textbooks as well as the copyright date of each. To simplify the task, teachers were given a list of commonly used textbooks/programs in the particular science subject and grade range of the class (see Appendix D). If the textbook or program appeared on the list the teacher need only write the copyright date and circle the frequency of use (never used, use occasionally, used frequently, or the one used most often). For books not on the list, teachers were asked to write in the title, author, publisher, and copyright date.

As shown in Table 9, about half of all science classes use a single published textbook/program, and about 40 percent use multiple textbooks. Relatively few classes in any grade range category do not use any published textbooks/programs, with the possible exception of K-3, with 13 percent. This is a significantly lower percentage than the 1977 national survey result of 37 percent for K-3 science classes using no textbook.

Table 9

Percent Of Classes Using None, One, Two, Three, And Four Or More Textbooks/Programs By Grade Range

Number of Texts	K-3	4-6	7-9	10-12	K-12 Total
None	13 (37)+	8 (10)	1 (6)	1 (8)	5 (18)
One	55 (46)	59 (56)	41 (48)	42 (48)	48 (49)
Two	19 (13)	17 (22)	23 (25)	19 (29)	20 (21)
Three or More	11 (5)	12 (12)	22 (21)	32 (15)	19 (12)
Missing	2	4	14	6	8
Sample N	161	179	242	222	804

+ Results of 1977 national survey in ( ).

The most commonly used textbooks/programs in each science subject/grade range category are shown in Table 10. Tables B.2 to B.8 in Appendix B list the frequency of use of all textbooks/programs which are being used by one percent or more of the classes in each science subject/grade range category.

Table 10

Most Commonly Used Science Textbooks/Programs*

Percent of Classes	Textbook/Program (Author)	Publisher
K-6 Science		
14	Science: Understanding Your Environment (Mallinson)	Silver Burdett
13	Concepts in Science (Brandwein)	Harcourt
10	Accent on Science (Sund)	Merrill
10	Science Curriculum Improvement Study (SCIS)	Rand McNally
7-9 Life Science		
31	Focus on Life Science (Heimler)	Merrill
16	Life Science (Ramsey)	Holt
11	Living Things (Fitzpatrick)	Holt
7-9 Earth Science		
29	Modern Earth Science (Ramsey)	Holt
24	Focus on Earth Science (Bishop)	Merril
14	Earth Science (Ramsey)	Holt
7-9 Physical Science		
27	Introductory Physical Science (IPS) (Haber-Schaim)	Prentice Hall
15	Modern Physical Science (Tracy)	Holt
12	Focus on Physical Science (Heimler)	Merrill
10-12 Biology		
42	Modern Biology (OHO)	Holt
13	Biology: Living Systems (Oram)	Merrill
13	Biological Science: An Ecological Approach (BSCS Green)	Rand McNally
10-12 Chemistry		
39	Modern Chemistry (Metcalfe)	Holt
15	Chemistry: Experiments & Principles (CHEM Study)	D.C. Heath
10-12 Physics		
49	Modern Physics (Williams)	Holt
21	Physics: Principles and Problems (Murphy)	Merrill
13	The Project Physics (Rutherford)	Holt
13	PSSC Physics (Haber-Schaim)	D.C. Heath

* In classes which are using multiple textbooks/programs, only the one designated "used most often" was included in these analyses.

C. Copyright Dates of Textbooks/Programs

The copyright dates of the textbook/program designated as "the one used most often" were examined to determine the age of the textbooks used in science classes. The result of this analysis is shown in Table 11. Note that almost half of the teachers in each grade range omitted the copyright date of the textbook/program used most often in that class.

For the most part, differences among grade levels in age of books are small. Elementary classes are more likely to use newer textbooks (copyright dates between 1980 and 1983); secondary classes are more likely to use textbooks 5 to 8 years old.

Table 11

Percent of Classes Using Textbooks With Copyright Dates Before 1976, 1976-79, And 1980-83 By Grade Range*

Grade Range	N	Before 1976	1976 to 1979	1980 to 1983	Missing	No Text Used
K-3	161	7	11	20	49	13
4-6	179	13	11	23	45	8
7-9	242	9	30	18	42	1
10-12	222	13	26	18	42	1
K-12 Total	804	10	21	20	44	5

* The copyright date of the textbook designated as "used most often" was used for this analysis.

D. Use of Federally-Funded (NSF) Curriculum Materials

Principals were given a list of names and code numbers for science curriculum materials which were developed with federal funds (mostly through the National Science Foundation, NSF) for use in one or more of the grades K-12. Principals who indicated that one or more of these materials were used in their schools were instructed to list the code numbers of the ones used (see Appendix D). For the teachers, the federally-funded curricula were included in the general list of published textbooks/programs on their questionnaires. Teachers were asked to indicate how frequently the programs were used.

Table 12 shows the percent of schools and the percent of teachers using one or more of these selected federally-funded science curriculum materials. Elementary and secondary teachers are equally likely to be using at least one of these materials (29 and 30 percent, respectively), in contrast to the 1977 national survey results, where secondary teachers were significantly more likely than elementary teachers to be using federally-funded materials.

Table 12

Percent of Schools and Teachers Using at Least One of The Federally Funded Science or Interdisciplinary Curricula, By Grade Range

	Schools		Teachers*	
	K-6	7-12	K-6	7-12
Yes	38 (31)+	48 (52)	29 (23)	30 (43)
No	49	35	68 (65)	60 (52)
Missing	13	17	3 (12)	10 (5)
Sample N	216	270	340	464

* All teachers who reported using the curriculum "occasionally," "frequently," or "most often" were included in this analysis.

\+ Results of 1977 national survey

Table B.9 in Appendix B shows principal responses to the question "Are there any of the materials on the list being used in your school during the 1982-83 school year?" broken down by type of community, school size, and percent of students in free-lunch program. Only principals who said yes and then listed one or more of the materials are included in this analysis. Appendix Table B.10 lists the percentages of schools which are using each of the listed federally funded curriculum materials.

Schools in small cities, urban, and suburban areas are more likely than schools in rural areas to be using one of these materials. Similarly, large schools are more likely than smaller schools to be using these materials. Finally, schools with a very small percentage of students who qualify for the federal free lunch program are significantly more likely to be using these materials than those with larger percentages of students from low-income families.

Table 13 shows the percent of schools and teachers using each of a number of federally funded curriculum materials. At the elementary level, SCIS and ESS are used by 17 and 13 percent of the teachers respectively. At the secondary level, usage ranges from 1 to 13 percent (for BSCS green version and IPS). Analysis by type of science taught show that approximately 70 percent of all biology teachers are using one of the BSCS materials at least occasionally, approximately 25 percent of the chemistry teachers are using CHEM STUDY, and approximately 67 percent of the physics teachers are using either the Project Physics course or PSSC physics or both.

Table 13

Use of Selected Federally Funded Science Curriculum Material

A. K-6

Curriculum Material	Percent of Schools	Percent of Teachers*
ESS	28	14
	(8)+	(7)
SAPA	4	4
	(9)	(6)
SCIS	18	17
	(12)	(11)

B. 7-12

	Percent of Schools 7-12	Percent of Teachers 7-9	10-12
BSCS Green	18	1	13
	(14)	(3)	(17)
BSCS Yellow	4	0	6
	(13)	(5)	(13)
BSCS Blue	5	0	7
	(10)	(6)	(5)
ECSP	8	7	0
	(5)	(10)	(4)
IPS	26	13	0
	(15)	(9)	(7)
ISCS	2	1	0
	(8)	(12)	(2)
CHEM Study	13	0	8
	(5)	(1)	(7)
PSSC Physics	10	0	9
	(6)	(1)	(4)
Project Physics	8	0	11
	(8)	(2)	(10)

* Teachers who reported using the curriculum "occasionally," "frequently," or "most often" were included in this analysis.

+ Results of 1977 national survey.

Note that there appears to be discrepancies in the usage data for principals and teachers. These discrepancies may be due in part to errors of measurement. For example, a principal may not know all of the textbooks/programs being used in the school, or a teacher may not know that in addition to a textbook currently in use, the federally funded curriculum materials are also available at the school. It is also possible that some respondents did not recognize that a given curriculum material on the list is in fact the same as the textbook/program in use. Since teachers are more apt to be familiar with the textbooks they are using, the data collected from the teachers are less likely to be subject to those measurement errors.

E. Involvement in Textbook Selection

Table 14 shows principal perceptions of the individuals and groups involved in school textbook selection. Students, parents, and school board members have rather low involvement in textbook selection; 76 percent reported that students are not involved, 64 percent that parents are not involved, and 73 percent that school board members are not involved. About half of the principals indicated that they themselves are heavily involved in the textbook selection process in their schools, while only 4 percent are not involved.

Table 14

Principals' Perceptions Of Individuals Involved
In School Textbook Selection

	Percent of Schools			
	Not Involved	Somewhat Involved	Heavily Involved	Don't Know/ Missing
Superintendent or Assist. Supt.	47 (23)*	35 (35)	11 (17)	7 (25)
District-Wide Supervisors	30 (15)	16 (23)	30 (31)	24 (31)
Principals	4 (2)	39 (39)	56 (56)	1 (3)
Teacher Committees	4 (2)	9 (16)	85 (70)	2 (12)
Individual Teachers	3 (3)	32 (..)	62 (62)	3 (3)
School Board Members	73 (47)	19 (21)	0 (3)	8 (30)
Parents	64 (57)	27 (23)	2 (3)	7 (17)
Students	76 (62)	16 (20)	0 (1)	8 (18)

Sample N = 486

* Results of 1977 national survey in ( ).

Only 11 percent of the superintendents or assistant superintendents are heavily involved in textbook selection, while district-wide science supervisors are heavily involved in 30 percent of the schools. The large percentage of "don't know" and missing responses (and perhaps the many "not involved" responses) are likely due to that fact that many districts have no district-wide science supervisors.

Teacher committees and individual teachers are the groups most heavily involved. Only 3 percent of the schools indicated that individual teachers are not involved in textbook selection, and only 4 percent that teacher committees are not involved. In fact, teacher committees are used in the textbook selection process significantly more in Minnesota than in the 1977 national survey results.

While teachers in this survey were not asked about their involvement in science textbook selection, many teachers indicated that they are satisfied with the textbooks/programs they are using. As shown in Table 15, when asked to indicate the textbook/program they would use for teaching science that particular class if given a free choice, 55 percent of the teachers indicated they would choose the one they are currently using (satisfaction with current textbook increased with increasing grade range). Approximately one-fourth of each group would choose another textbook/program, and the remaining teachers did not indicate their preferences.

Table 15

Teachers' Preferences For Textbooks/Programs
By Grade Range

Textbook/Program Preferred	Percent of Classes				K-12 Total
	K-3	4-6	7-9	10-12	
Current One	48 (43)+	39 (46)	58 (63)	70 (62)	55 (52)
One used previously	3 (2)	7 (11)	5 (11)	9 (8)	6 (8)
Other	20 (22)	29 (25)	15 (17)	10 (19)	18 (21)
Missing	30 (32)	26 (17)	22 (9)	12 (11)	21 (19)
Sample N	161	179	242	222	804

+ Results of 1977 national survey ( ).

CHAPTER 4

Instructional Techniques And Classroom Activities

A. Overview

Each teacher was asked to indicate the frequency of use of each of a number of teaching techniques, including lecture/discussion, reading from a textbook, and field trips. In addition, each secondary teacher was asked to report the method used for teaching safety procedures. The data are reported in the following sections.

B. Teaching Techniques

The frequency of use of each of a number of teaching techniques in science instruction are reported in Table 16. These results are broken down by grade range, science subject, and strata in Appendix Tables B.11 to B.14. The percent of teachers using selected techniques at least once a week or more often is shown in Table 17.

Table 16

Frequency Of Use Of Various Teaching Techniques In Science Classes*

Teaching Technique	Never	Less Than Once A Month	At Least Once A Month	At Least Once A Week	Just About Daily	Missing
Lecture/Discussion	0	2	5	42	41	10
Student reports or projects	15	40	23	11	1	9
Library Work	29	44	14	3	0	10
Students work at Chalkboard	39	30	13	7	1	10
Students read from text	19	9	12	30	22	10
Students answer questions/problems from text	11	6	15	40	18	10
Students use hands-on or manipulative lab materials	2	10	22	44	12	9
Films, videotapes, or filmstrips	3	13	38	35	2	9
Computer-assisted instruction	60	22	5	3	0	11
Tests or quizzes	10	9	35	36	1	10
Field trips, excursions	44	43	4	1	0	9
Teacher demonstrations	3	16	36	33	4	9

* Sample N = 804

Table 17

Percent Of Teachers Using Selected Techniques
At Least Once A Week Or More Often, By Grade Range

Teaching Technique	Grade Range K-3	4-6	7-9	10-12
Lecture/Discussion	71	87	81	92
Students work from text (read or answer problems)	47	66	70	77
Students use hands-on materials	47	42	61	71
Films, video-tapes, or film-strips	39	33	44	31
Tests or quizzes	3	28	52	54
Teacher Demonstrations	32	31	38	42

In general, the predominant modes of science instruction are lecture/discussion and individual assignments such as reading from a textbook, answering questions or problems from a textbook, and taking tests and quizzes. Watching films and teacher demonstrations are also frequently used techniques. There were few differences by grade range, science subject, or strata. These results are consistent with John Goodlad's study of schooling in America[1]. Goodlad found that at all grade levels in all subjects "...students engage in a rather narrow range of classroom activities..., students listened; they responded when called on to do so; they read short sections of textbooks; they wrote short responses to questions or chose from among alternative responses in quizzes... Most of the time they listened or worked alone."

The frequency of use of each teaching technique is discussed separately below.

1. Lecture/Discussion

Lecture/discussion is the predominant mode of science instruction at all grade ranges. Over 80 percent of science classes have lecture/discussion once a week or more often; for approximately 40 percent of the classes the occurrence is just about daily. Only 2 percent of classes use lecture/discussion less than once a month.

[1] John Goodlad, A Place Called School; Prospects for the Future, McGraw Hill, 1984, p. 124.

2. Student Reports or Projects

Student reports and projects are used by 35 percent of the classes at least once a month or more often, with only 15 percent of science classes never using them. 4-6 teachers use student reports and projects most, while 10-12 teachers use them least (56 and 28 percent, respectively, once a month or more often).

3. Library Work

Library work is not very common in science classes. Twenty-nine percent of classes never do library work, while 44 percent do library work less than once a month. K-3 and 10-12 classes are less likely than 4-6 and 7-9 classes to do library work.

4. Students Working at Chalkboard

Chalkboard work is also not very common in science classes. Thirty-nine percent of classes never do chalkboard work, and 30 percent work at a chalkboard less than once a month.

5. Students Reading from a Textbook

Over half the science classes have students reading from a textbook once a week or more often; only 19 percent never read from a book. The percentage of use at least once a week or more often is higher for grades 10-12 (74 percent) and grades 4-6 (66 percent) than for grades 7-9 (56 percent) and grades K-3 (42 percent).

6. Students Answering Questions Or Problems From A Textbook

Almost 60 percent of all science classes answer questions from a textbook at least once a week or more often; only 11 percent never use a textbook for this purpose. The percentage of use at least once a week or more often is higher for grades 10-12 (74 percent) and grades 7-9 (62 percent) than for grades 4-6 (53 percent) and grades K-3 (36 percent). As expected, for 10-12 science classes, a larger percentage of chemistry (86 percent) and physics (82 percent) classes answer questions from a textbook at least once a week or more often than do biology classes (56 percent).

7. Students Use Hands-On, Manipulative, or Laboratory Materials

About half the science classes have hands-on experiences at least once a week or more often; only 2 percent never use manipulatives, while 10 percent have hands-on experiences less than once a month. Hands-on experiences are more frequent in 10-12 classes (71 percent at least once a week or more often) and 7-9 classes (61 percent) than in 4-6 (42 percent) and K-3 classes (47 percent). In high schools, hands-on laboratory experiences are more frequent in biology and chemistry classes (77 and 81 percent, respectively, once a week or more often) than in physics classes (54 percent).

Of special concern is the elementary level; 4 percent of the K-3 classes never use hands-on, and 14 percent have hands-on experiences less than once a month. Similarly, 5 percent of the 4-6 classes never use hands-on, and 20 percent have hands-on experiences less than once a month.

8. Films, Video-tapes, or Filmstrips

Thirty-seven percent of all science classes are shown films, video-tapes, or filmstrips at least once a week or more often, and 38 percent see films at least once a month. The use of films at least once a week is slightly higher for 7-9 classes (44 percent) and K-3 classes (39 percent) than for 4-6 (33 percent) and 10-12 (31 percent) classes.

9. Computer-assisted instruction

Computer-assisted science instruction is still rare in Minnesota schools. Sixty percent of all science classes never use computer-assisted instruction, and 22 percent use it less than once a month. For more details on the use of computers in science instruction, see Chapter 9.

10. Tests or Quizzes

Except for K-3 classes, the vast majority of science classes use tests or quizzes. They are particularly frequent in secondary classes, where about 50 percent of all classes use tests or quizzes at least once a week.

11. Field Trips and Excursions

Field trips and excursions are common in elementary science classes (used in 72 percent of K-3 classes and 61 percent of 4-6 classes). They are not used as frequently in secondary science classes (34 percent of 7-9 classes and 35 percent of 10-12 classes).

12. Teacher Demonstrations

Teacher demonstrations are common in science classes; 37 percent of all classes observe a teacher demonstration at least once a week, and only 3 percent never observe a demonstration. As shown in Table 18, the percentages using demonstrations increases slightly with increasing grade level.

C. Safety Procedures

Secondary science teachers were asked if they had attended a safety workshop within the last five years. They were also asked how safety procedures were taught to their students. The results are shown in Tables 18 and 19.

About one-quarter of all science teachers have attended a safety workshop within the past five years (the percentage is highest for 10-12 chemistry teachers and lowest for 7-9 life science teachers). Almost 60 percent of the science teachers teach safety procedures as they are needed; 34 percent teach some safety procedures in a specific unit and introduce additional procedures as they are needed.

Table 18

Percent of Secondary Science Teachers Who Have Attended A Safety Workshop Within The Last Five Years By Science Subject

Attended Safety Workshop	Science Subject 7-9 Life	7-9 Earth	7-9 Physical	10-12 Biology	10-12 Chemistry	10-12 Physics	7-12 Total
Yes	14	22	21	22	38	22	23
No	82	76	69	77	60	72	73
Missing	4	2	10	1	3	6	4
Sample N	71	79	84	82	72	68	456

Table 19

Percent Of Secondary Science Teachers Using Different Methods To Teach Safety Procedures, By Science Subject

Safety Procedures	Science Subject 7-9 Life	7-9 Earth	7-9 Physical	10-12 Biology	10-12 Chemistry	10-12 Physics	7-12 Total
Procedures introduced as needed	69	61	51	67	51	62	60
Procedures taught in specific unit, and additional procedures as needed	27	37	38	30	46	32	35
Missing	4	2	11	2	3	6	5
Sample N	71	79	84	82	72	68	456

CHAPTER 5

Science Facilities, Equipment, And Supplies

A. Overview

Information about facilities, equipment, and supplies was collected from both principals and teachers. Principals indicated if their schools had specific budgets for science equipment and for science supplies and, if so, the amounts of these budgets. Teachers rated aspects of the adequacy of facilities, equipment, and supplies. Secondary principals and teachers provided information about safety audits and the source of money used to correct safety problems. The results of these analyses are presented in the following sections.

B. School Budgets for Science Equipment and Supplies

Principals were asked to indicate if their schools have an annual budget specifically for the purchase of new science equipment[1] and, if so, to specify the total amount of this budget for the 1982-83 school year. Principals were also asked to provide this information about the budget for consumable science supplies[2]. The results for these questions are shown on Table 20. Frequency distributions of the per pupil equipment and supply budgets for each grade range are shown in Appendix Tables B.15 to B.17.

Relatively few schools have specific budgets for science equipment (ranging from 33 percent for K-6 schools to 53 percent for 10-12 schools). A larger percentage of schools have science supply budgets (ranging from 57 percent for K-6 schools to 74 percent for 10-12 schools). In general, secondary schools are significantly more likely than elementary schools to have specific budgets for science equipment and supplies. A larger percentage of Minnesota schools have equipment and supply budgets in the 1982-83 school year than the national averages for the 1976-77 school year.

The per pupil equipment and supply budgets vary widely from school to school (a range of $10.12 to $11.68 per pupil), and the distributions are highly skewed (see Appendix Tables B.15 to B.17). As expected, the per pupil equipment and supply budgets increase with increasing grade level. Thus, the per-pupil amounts of these budgets for schools which include one or more of the grades 7-12 are significantly larger than those for elementary schools. With the exception of elementary schools, the per pupil budgets for science supplies are significantly larger (by about $1.20) than the budgets for new equipment. In addition, Minnesota equipment budgets are significantly smaller than those reported in the 1976-77 national survey.

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[1] Science equipment was defined as nonconsumable, non-perishable items such as microscopes, scales, etc.

[2] Consumable science supplies were defined as materials that must continually be replenished such as chemicals, glassware, batteries, etc.

Table 20

Percent Of Schools With Specific Budgets For Science Equipment And Science Supplies, And Average Amount Of These Budgets Per Pupil By Grade Range*

	Science Equipment				Science Supplies			
Sample Grade Range	Sample N	Percent of Schools	Avg. Budget Amount	Standard Error	Sample N	Percent of Schools	Avg. Budget Amount	Standard Error
K-6	72	33 (16)+	$1.95 ($3.05)	.24	123	57 (20)	$1.77 ($1.56)	.22
7-9	129	55 (21)	$2.40 ($5.03)	.16	184	79 (29)	$3.46 ($3.62)	.18
10-12	90	53 (44)	$2.49 ($5.46)	.20	126	74 (57)	$3.84 ($4.02)	.22

* Schools which said there was a specific budget but did not indicate the amount, and schools which did not indicate total enrollment were not included in the calculations of average amounts per pupil.

+ Data from 1977 national survey shown in ( ).

Tables 21 and 22 show the breakdown of per pupil equipment and supply budgets by size of school and type of community. Small schools have a significantly larger per pupil equipment budget than medium or large schools. Although small schools also have the largest supply budget, the differences in supply budgets for small, medium, and large schools are not significant. Rural schools have the largest equipment budget ($2.90) followed by small city ($2.28), suburban ($1.79), and urban schools with the smallest budget ($1.49). With the exception of urban compared to suburban schools, all differences are statistically significant. Small cities have the largest supply budget for science ($3.59), followed by rural ($3.09) and suburban ($3.00), and urban with the smallest supply budget ($1.36). The urban supply budget is significantly smaller than the rural, small city, and suburban supply budgets.

Table 21

Average Amounts Of Science Equipment And Supply Budgets Per Pupil By Size Of School*

Size of School	Science Equipment		Science Supplies	
	Average Budget Amount	Standard Error	Average Budget Amount	Standard Error
Small	$3.33	0.30	$3.30	0.35
Medium	$2.25	0.22	$2.82	0.22
Large	$1.74	0.16	$3.01	0.21
Sample N	162		269	

* See Appendix A for a description of this variable.

Table 22

Average Amount Of Science Equipment And Supply Budgets Per Pupil By Type of Community*

Type of Community	Science Equipment		Science Supplies	
	Average Budget Amount	Standard Error	Average Budget Amount	Standard Error
Rural	$2.90	0.26	$3.09	0.25
Small City	$2.28	0.26	$3.59	0.32
Urban	$1.45	0.27	$1.36	0.22
Suburban	$1.79	0.18	$3.00	0.23
Sample N	161		267	

* See Appendix A for a description of this variable.

C. Elementary School Facilities

Each elementary teacher was asked to indicate the type of room in which the class was conducted. The results for K-3 and 4-6 science classes are shown on Table 23. Sixty percent of all elementary science classes are taught in classrooms with portable science materials. Only 3 percent of the science classes (and virtually all of these are grade 4-6 classes) are conducted in laboratories or special science rooms, while 29 percent of K-3 science classes and 34 percent of 4-6 science classes are conducted in classrooms with no science facilities at all.

Table 23

Percent Of Elementary Science Classes Conducted
In Various Types of Rooms, By Grade Range

Type of Room	Grade Range		
	K-3	4-6	K-6 Total
Laboratory or special science room	1 (0)+	5 (9)	3 (4)
Classroom with portable science materials	63 (54)	56 (54)	60 (54)
Classroom with no science facilities	29 (38)	34 (34)	31 (36)
Missing	8 (8)	5 (3)	6 (6)
Sample N	161	179	340

+ Results of 1977 national survey in ( ).

D. Ratings of The Adequacy of Science Facilities, Equipment and Supplies

Teachers were asked to rate the adequacy of facilities, equipment, and supplies for teaching a particular class; response options were "very good," "satisfactory," "improvement needed," and "not relevant to this class." Table 24 shows the percent of science classes in each grade range for which teachers indicated that improvement is needed in each area. Complete data by grade range, science subject, and district strata are presented in Appendix Tables B.18 to B.21.

The availability of laboratory assistants or paraprofessional help is a major problem for all science teachers, with teachers in 60 percent of science classes rating this area as "improvement needed." Science supplies are considered inadequate by many teachers: 42 percent of elementary teachers indicated that science supplies need improvement, while 48 percent of all teachers indicated that money to buy supplies on a day-to-day basis needs improvement. Elementary teachers also perceive equipment as a major problem, especially 4-6 teachers (61 percent indicated improvement needed). Teachers in school districts in

the seven county metro suburbs (Stratum 2), and in districts which enroll more than 2000 students (Stratum 3), consistently rated equipment, supplies, and money to buy supplies as more satisfactorly than teachers in other districts, particularly in cities of the first class and districts which enroll less than 1000 students. For example, only 27 percent of the teachers in the seven county metro suburbs and in districts which enroll more than 2000 students rated equipment as "needs improvement" compared to 57 percent in cities of the first class and 51 percent in districts with less than 1000 students. Similarly, 50 percent of the teachers in cities of the first class and 40 percent in districts which enroll less than 1000 students rated supplies as "needs improvement" compared with only 22 percent in the seven county metro suburbs and in districts which enroll more than 2000 students.

Table 24

Percent Of Classes For Which Teachers Indicated Improvement Needed In Facilities, Equipment, Or Supplies By Grade Range

Facilities, Equipment, Supplies	Grade Range K-3	4-6	7-9	10-12	K-12 Total
Facilities-- building and classroom fixtures	27 (27)+	43 (42)	26 (44)	21 (34)	29 (36)
Equipment-- nonconsumable, nonperishable items such as microscopes, scales, etc.	44 (46)	61 (55)	24 (38)	22 (35)	36 (45)
Supplies-- materials that must continually be replenished, such as chemicals, dry cells	34 (38)	50 (53)	18 (27)	20 (21)	29 (36)
Money to buy supplies on day-to-day basis	58 (49)	58 (57)	37 (57)	44 (47)	48 (53)
Storage space for equipment and supplies	40 (40)	57 (50)	29 (42)	30 (39)	38 (42)
Space available for classroom preparation	40 (30)	55 (50)	24 (39)	21 (28)	33 (37)
Spaces for small groups to work	39 (35)	65 (54)	46 (56)	44 (44)	48 (46)
Availability of laboratory assistants or paraprofessional help	56 (48)	68 (56)	57 (72)	59 (62)	60 (58)

+ Results of 1977 national survey in ( ).

Each of the other areas -- facilities, storage space, space for classroom preparation, and space for small groups to work -- was rated "improvement needed" for between 29 and 38 percent of science classes. In general, elementary teachers perceived the areas of equipment, supplies, storage space, and space for classroom preparation as more of a problem than secondary teachers. 4-6 teachers consistently rated each area as more of a problem (by about 15 percent) than K-3, 7-9, or 10-12 teachers.

E. Safety in Secondary Schools

Secondary school principals and teachers were asked if a safety audit had been conducted at their schools within the last two years. The results are shown in Table 25. They were also asked to indicate the source of money used to correct any safety problems that might arise in the school. The results of this analysis are shown in Table 26.

Table 25

Percent of Secondary Principals And Teachers Reporting
A Safety Audit At School Within The Last Two Years

Safety Audit	Principals 7-12	Teachers 7-9	Teachers 10-12	7-12 Total
Yes	80	53	66	59
No	17	35	28	32
Missing	3	12	5	9
Sample N	270	242	222	464

Table 26

Secondary Principal And Teacher Perceptions Of
Source Of Money To Correct Safety Problems

Source of Money	Percent of Principals 7-12	Percent of Teachers 7-9	10-12	7-12 Total
From the science budget	12	27	26	26
From the safety budget	7	5	5	5
From some other budget	74	41	50	45
Missing	8	29	22	25
Sample N	270	242	222	464

Eighty percent of the principals and only 59 percent of the teachers reported a safety audit within the last two years. Similarly, teachers were twice as likely as principals to report that money to correct safety problems comes from the science budget (27 percent and 12 percent, respectively). Three-fourths of the principals indicate that money to correct safety problems comes from some other budget, not from the science budget or a safety budget. Since principals are more likely than teachers to be knowledgable about budgets and school safety budgets, the principal data may be less likely to be subject to measurement error than the teacher data.

CHAPTER 6

Qualifications Of Principals And Science Teachers

A. Overview

Principals were asked about their undergrade majors and their qualifications for supervising instruction in a number of subjects. The teacher questionnaires were used to collect data about teacher characteristics such as sex, undergraduate and graduate credits in science, and number of years teaching experience. In addition, teachers were asked about their qualifications for teaching a number of subjects and about aspects of teaching in which they felt a need for additional assistance. The results are presented in the following sections.

B. Teacher Characteristics

Teachers were asked to indicate their age and the number of years they have taught, including 1982-83 as a full year. As shown in Table 27, the average age of teachers is 41 years; the average age of teachers in the subject/grade range categories of interest in this study are very similar[1]. As shown in Table 28, the average number of years of teaching experience is 16.7 years, about 6 years more than the average reported in the 1976-77 national survey. This difference is probably due to declining student enrollments; by seniority rules, teachers with the least number of years teaching experience are laid off. Note that the average number of years teaching experience for teachers in the subject/grade range categories are very similar[1]. 10-12 biology and chemistry teachers have about 2 years more teaching experience than K-9 teachers.

Similarly, there are few significant differences in the average ages and years teaching experience by district strata; the largest difference is about 4 years (see Appendix Tables B.22 and B.23).

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[1] Even though a few of the differences between groups are statistically significant, the magnitude of those differences is small.

Table 27

Average Age Of Teachers By Grade Range And Science Subject

Grade Range	Sample N	Average Age	Standard Error
K-3	153	41	.84
4-6	172	41	.67
7-9 Life	71	40	1.22
7-9 Earth	78	42	1.08
7-9 Physical	83	41	1.00
10-12 Biology	79	43	.99
10-12 Chemistry	72	43	1.04
10-12 Physics	68	41	1.07
K-12 Total	776	41	.33

Table 28

Average Number Of Years Teaching Experience
By Grade Range And Science Subject

Grade Range	Sample N	No. of Years	Standard Errors
K-3	160	16.2 (10.4)+	.69
4-6	174	15.6 (10.5)	.49
7-9 Life	70	16.1	1.03
7-9 Earth	79	16.9	.94
7-9 Physical	82	16.5	.95
7-9 Total	231	16.7 (11.5)	.55
10-12 Biology	82	18.5	.83
10-12 Chemistry	72	18.3	.97
10-12 Physics	68	16.8	.99
10-12 Total	222	18.0 (11.8)	.54
K-12 Total	795	16.7 (10.8)	.29

+ Results of 1977 national survey in ( ).

Tables 29 and 30 show that very few elementary teachers have undergraduate or graduate science concentrations. In fact, over 50 percent of elementary teachers have only 0-20 college quarter credits in the natural sciences[2]. Almost all secondary science teachers have an undergraduate science concentration, and over 50 percent have a graduate science concentration, with a total of over 100 college quarter credits in the natural sciences. As shown in Table 31, 65 percent of all science teachers have taken a course for college credit within the last three years. Elementary teachers are more likely than secondary teachers to have taken a course within the last three years (74 percent and 58 percent, respectively). About one-quarter of the 10-12 science teachers took their last course for college credit over 6 years ago.

Table 29

Percent Of Teachers With A College Science Concentration, By Grade Range

Grade Range	Sample N	Undergraduate Science Major and/or Minor	Graduate Science Concentration
K-3	161	6	3
4-6	179	7	2
7-9	242	95	53
10-12	222	97	69

Table 30

Percent Of Teachers With Varying Numbers Of Natural Science College Credits, By Grade Range

	Percent of Teachers				K-12 Total
	K-3	4-6	7-9	10-12	
0-20 credits	57	54	1	0	24
21-50 credits	39	39	5	14	19
51-75 credits	2	4	19	16	11
76-100 credits	1	1	24	25	14
Over 100	0	0	47	53	29
Missing	2	3	4	3	3
Sample N	161	172	242	222	804

[2] Natural sciences were defined as botany, biology, zoology, astronomy, chemistry, physics, geology, etc.

Table 31

Percent Of Teachers Whose Last College Course Was Before 1977, 1977-79, Or 1980-83, By Grade Range

Grade Range	Sample N	Prior To 1977	1977-1979	1980-1983	Missing
K-3	161	8	12	74	6
4-6	175	10	12	74	3
7-9	242	17	17	60	7
10-12	222	23	17	55	5
K-12 Total	804	15	15	65	5

Teachers were asked to indicate their Minnesota teacher certification areas. The results are shown in Table 32. In 7-9 Life Science, 10-12 Biology, and 10-12 Chemistry, over 50 percent of the teachers indicate certification in these areas, while between 20 and 40 percent have the All Sciences certification. On the other hand, in 7-9 Earth Science, 7-9 Physical Science, and 10-12 Physics, about one-third of the teachers indicated certification in these areas, while about 50 percent have the All Sciences certification.

Table 32

Percent+ Of Teachers With Different Certification Areas, By Science Subject

Certification Area	7-9 Life	7-9 Earth	7-9 Physical	10-12 Biology	10-12 Chemistry	10-12 Physics
Elementary	1	5	0	2	3	0
Middle School/ Junior High	46	28	23	22	11	10
Life Science	76	35	33	65	19	7
Earth Science	30	32	18	10	15	9
Physical Science	17	9	28	9	36	29
Chemistry	21	14	29	20	57	32
Physics	4	5	15	0	31	38
Sciences (All)	21	46	47	30	40	50
Sciences (All Except Earth)	3	1	0	1	1	3
Sample N	70	78	82	82	72	68

+ Since teachers could report more than one certification area, percentages do not add up to 100%.

Table 33 shows the breakdown of teacher sex by grade range. As expected, very few elementary teachers are male, and the proportion of male teachers increases with grade. Only 6 percent of K-3 teachers are male; the figures are 46 percent for grades 4-6, 82 percent in grades 7-9 science, and 91 percent in grades 10-12 science. There are significantly fewer female secondary science teachers in Minnesota than reported in the 1976-77 national survey.

Table 33

Teacher Sex By Grade Range

Grade Range	Sample N	Male	Female	Missing
K-3	161	6 (2)+	93 (98)	1 (0)
4-6	179	46 (33)	52 (67)	2 (0)
7-9	242	82 (62)	18 (38)	0 (0)
10-12	222	91 (74)	10 (24)	0 (2)

+ Results of 1977 national survey in parentheses.

To provide additional background information, teachers were asked about their qualifications for teaching. Elementary teachers rated their qualifications for teaching each of 4 subjects -- mathematics, science, social studies, and reading; these results are shown in Table 34. Elementary teachers' perceptions about their qualifications for teaching the various subjects are consistent with the amount of time that is generally spent in instruction in these areas. Nearly 80 percent of elementary teachers feel "very well qualified" to teach reading. The corresponding figures for mathematics, social studies, and science are 64 percent, 49 percent, and 26 percent, respectively. At the other end of the scale, 16 percent of elementary teachers feel "not well qualified" to teach science. With the exception of science, Minnesota teachers feel better qualified to teach mathematics, social studies, and reading (by about 14 percent) than the averages reported in the 1976-77 national survey.

Table 34

Elementary Teachers' Perception Of Their Qualifications To Teach Each Subject

Subject	Not Well Qualified	Adequately Qualified	Very Well Qualified	Missing
Mathematics	2 (4)+	34 (46)	64 (49)	1
Science	16 (16)	57 (60)	26 (22)	1
Social Studies	2 (6)	48 (54)	49 (39)	0
Reading	1 (3)	20 (32)	79 (63)	0
Sample N = 340				

+ Results of 1977 national survey ( ).

As shown in Table 35, most secondary science teachers teach science courses only (80 percent). An additional 12 to 15 percent teach science and math or science and another subject (frequently Study Hall). Secondary teachers were asked to indicate if they are teaching any science courses that they do not feel comfortable teaching, and if so, to specify the courses. The results are shown in Table 36. Fifteen percent of the 7-9 science teachers and 18 percent of the 10-12 science teachers are currently teaching one or more courses they do not feel comfortable teaching. The courses listed most often were earth science, physical science, and physics.

Table 35

Percent Of Secondary Science Teachers Teaching Various Combinations Of Subjects, By Grade Range

	Grade Range		7-12 Total
	7-9	10-12	
Science Only	79	81	80
Science and Math Only	7	11	9
Science and Social Studies Only	1	0	1
Science and Another Subject Only	4	4	4
Other Combinations	0	2	1
Unknown	9	3	6
Sample N	242	222	464

Table 36

Percent Of Secondary Teachers Who Are Currently Teaching A Science Course That They Do Not Feel Comfortable Teaching, By Grade Range

Grade Range	Sample N	Yes	No	Missing/ Inconsistent
7-9	242	15	83	2
10-12	222	18	81	1
7-12 Total	464	16	82	2

C. Teacher Enthusiasm for Teaching Science

Teachers were asked how their enthusiasm for teaching science has changed in recent years. The results are shown in Table 37. Overall, about one-third of all teachers indicated that their enthusiasm is about the same, while about one-third indicate increasing enthusiasm and one-third decreasing enthusiasm. The only differences by grade range are for K-3 teachers; 51 percent indicate increasing enthusiasm for teaching science, compared to 35 percent for 4-6 teachers and 28 percent for 7-9 and 10-12 teachers. Forty-one percent of 10-12 teachers indicated decreasing enthusiasm for science teaching.

Table 37

Teachers' Rating Of How Enthusiasm For Teaching Science Has Changed In Recent Years, By Grade Range

Enthusiasm	Grade Range K-3	4-6	7-9	10-12	K-12 Total
Decreasing alot	3	10	7	12	8
Decreasing a little	8	18	27	29	22
About the same	38	36	34	30	34
Increasing a little	35	24	19	19	23
Increasing alot	16	11	9	9	11
Missing	1	2	3	1	2
Sample N	161	179	242	222	804

D. Teacher Needs for Assistance

Teachers were given a list of 17 areas and asked to specify for each whether (1) they do not usually need assistance, (2) they would like assistance from a resource person (e.g., a coordinator, a consultant, or another teacher) but receive little or none, or (3) they would like assistance and receive adequate assistance. Table 38 summarizes the data by indicating the breakdown of teachers who would like assistance but receive little or none in varying numbers of areas. Only 7 percent of the teachers did not indicate a need for additional assistance in any of the areas; 21 percent specified from 1 to 4 areas, 38 percent from 5 to 8 areas, while 31 percent indicated a need for additional assistance in 9 or more areas.

Table 38

Percent Of Teachers With Varying Numbers Of Areas In Which They Need Assistance, By Grade Range

Grade Range	Sample N	0 Areas	1-4 Areas	5-8 Areas	9 or more Areas	Missing+
K-3	161	6	13	41	37	3
4-6	179	8	17	35	39	1
7-9	242	6	26	38	28	2
10-12	222	10	23	39	25	2
K-12 Total	804	7	21	38	31	2

* This includes all teachers who omitted 9 or more parts of the question.

Grade range results for individual areas of need are presented in Table 39. Complete results by grade range, science subject, and district strata are presented in Appendix Tables B.24 to B.27. More than 75 percent of all science teachers do not usually need assistance in establishing instructional objectives, lesson planning, actually teaching lessons, and maintaining discipline. Areas of greatest need include using computers in science instruction, obtaining information about instructional materials, and learning new teaching methods. Each of these areas is discussed below. There were no major differences by science subject or district strata.

1. Use of Computers in Science Instruction

   About two-thirds of all science teachers feel the need for additional assistance in obtaining information about how to use computers in science teaching, training in computer programming, obtaining information about available science computer software, and for readily available day-to-day help in the science classroom use of computers. Only about 12 percent of the teachers indicated they do not need assistance in these areas, while about 15 percent indicated that they are currently receiving adequate assistance in these areas.

2. Obtaining Information About Instructional Materials

   About one-half of all science teachers feel the need for additional assistance in obtaining information about instructional materials. Only 14 percent of the teachers are currently receiving adequate assistance in this area, while 30 percent do not need assistance in this area.

3. Learning New Teaching Methods

   About one-half of all science teachers also feel the need for additional assistance in learning new teaching methods. Thirty-one percent of the teachers do not need assistance in this area, while only 12 percent feel they are currently receiving adequate assistance in learning new teaching methods.

4. Implementing the Discovery/Inquiry Approach

   Many of the federally-funded curriculum development projects, as well as some of the more recent commercially developed materials, depend upon a discovery or inquiry approach. However, only about half of all science teachers feel they are competent in this area without assistance from a coordinator or other resource person. Overall, 37 percent of science teachers indicated they would like assistance but receive little or none; an additional 10 percent indicated they would like assistance and are currently receiving adequate assistance in this area.

Table 39

Percent Of Teachers Who Need Additional Assistance In Various Areas, By Grade Range

Areas	Grade Range K-3	4-6	7-9	10-12	K-12 Total
Establishing instructional objectives	27 (19)+	37 (18)	18 (13)	16 (17)	24
Lesson Planning	21 (14)	22 (13)	6 (6)	4 (10)	12
Learning New Methods	57 (44)	54 (47)	50 (46)	56 (43)	54
Actually Teaching Lessons	31 (20)	35 (20)	11 (10)	14 (9)	21
Obtaining Information about instructional materials	50 (40)	53 (48)	53 (47)	56 (41)	53
Obtaining subject matter information	37 (33)	51 (35)	39 (27)	28 (27)	38
Implementing discovery/ inquiry approach	35 (30)	42 (38)	38 (38)	32 (36)	37
Using manipulative or hands-on materials	37 (27)	44 (37)	31 (34)	24 (34)	33
Maintaining equipment	42 (29)	40 (28)	30 (30)	32 (36)	35
Working with small groups of students	40 (29)	39 (33)	30 (34)	28 (31)	34
Maintaining discipline	8 (7)	11 (11)	13 (10)	5 (5)	9
Articulating instruction across grades	28 (28)	43 (30)	39 (29)	35 (40)	36
Maintaining live animals and plants	34 (31)	39 (28)	22 (27)	20 (25)	27
Obtaining information about how to use computers in science teaching	67	65	65	60	64
Training in computer programming	58	55	61	54	57
Obtaining information about available science computer software	70	68	65	61	65
Readily available day-to-day help in classroom use of computers	68	67	65	60	65

+ Results of 1977 national survey in ( ).

5. Using Manipulatives or Hands-On Materials

Thirty-three percent of all science teachers indicated they would like assistance in the use of manipulatives, while only 10 percent feel they are receiving an adequate level of assistance in this area. These findings may help explain the fact that, as reported earlier, manipulative materials are used less than once a week in about half of all science classes. 7-9 Life Science teachers and 4-6 teachers expressed the most need for additional assistance (47 percent and 44 percent, respectively), while 10-12 teachers expressed the least need (24 percent).

6. Other Areas in Which Assistance is Needed

Obtaining subject matter information is considered an unmet need by 38 percent of all science teachers. The problem is particularly acute for 4-6 teachers, with 51 percent indicating a need for additional assistance in this area. Only 34 percent of all science teachers indicated that they do not need assistance in this area. Similarly, 36 percent of all science teachers indicated the need for additional assistance in articulating instruction across grade levels. 4-6 teachers (43 percent) and 7-9 teachers (39 percent) are more likely to perceive a need for assistance in this area.

About one-third of all teachers need additional assistance in working with small groups of students. Elementary teachers (40 percent of K-3 and 39 percent of 4-6 teachers) are more likely to perceive a need in this area than secondary teachers (30 percent of 7-9 and 28 percent of 10-12 teachers). Similar needs are perceived in the area of maintaining equipment. Overall, 35 percent of teachers need additional assistance in this area. Again, elementary teachers (42 percent of K-3 and 40 percent of 4-6 teachers) are more likely to perceive a need in this area than secondary teachers (30 percent of 7-9 and 32 percent of 10-12 teachers). Over one-third of the elementary teachers also need additional assistance in maintaining live animals and plants (37 percent of K-3 and 39 percent of 4-6 teachers).

E. Supervision/Coordination at the School Level

One potential source of instructional help for teachers is their school principal. However, there is evidence that principals may often not be prepared to give this assistance. Table 40 shows the distribution of undergraduate major areas among principals. Very few elementary or secondary principals majored in either mathematics or science, while about 25 percent majored in social studies. In addition, a considerable number of elementary school principals (30 percent) majored in reading, language arts, or English.

Table 40

Percent Of Principals With Various Undergraduate Majors, By Grade Range

Grade Range	Major Area					
	Mathematics	Science	Social Studies	Reading/ Language Arts/English	Other	Missing
K-6 (N=216)	4 (5)+	7 (9)	23 (28)	30 (22)	23 (29)	13 (7)
7-12 (N=270)	10 (6)	15 (11)	26 (29)	9 (13)	27 (29)	13 (12)

+ Results of 1977 national survey in ( ).

Of course, it is not necessary to have majored in a particular subject area in order to be competent to supervise instruction in that area. However, as Table 41 indicates, principals' perceptions of their qualifications for instructional supervision follow much the same pattern as their major areas, especially in the category of "very well qualified." Minnesota principals perceive themselves to be better qualified to supervise instruction in mathematics and science than the 1977 national survey averages; only 9 percent of Minnesota principals feel "not well qualified" to supervise science instruction, compared to 20 percent of the 1977 national survey principals.

Table 41

Percent Of Principals Who Feel Qualified To Supervise Each Subject By Grade Range

Subject Area	Not Well Qualified	Adequately Qualified	Very Well Qualified	Missing
Mathematics				
K-6 (N=216)	5 (10)+	47	48	0
7-12 (N=270)	13 (20)	50	36	1
Science				
K-6 (N=216)	8 (19)	56	36	0
7-12 (N=270)	9 (21)	50	40	1
Social Studies				
K-6 (N=216)	5 (4)	45	49	1
7-12 (N=270)	3 (5)	41	55	1
Reading/English				
K-6 (N=216)	4 (6)	34	61	1
7-12 (N=270)	15 (18)	45	40	0

+ Results of 1977 national survey ( ).

Principals were also asked if they had any department chairperson, and if so, were they given released time on additional salary to carry out their duties. The results, in Table 42, show that one-third of the schools with grades 7-12 have no department chairperson, while 51 percent of K-6 schools do not have department chairperson. Clearly, many K-6 teachers do not get assistance from this source. Table 43 shows that small schools are more likely to have department chairperson who are compensated with released time or additional salaries than medium or large schools.

Table 42

Status Of Department Chairpersons By Grade Range

Sample Grade Range	Percent of Schools			Missing
	No Chairperson	Chairperson Not Compensated	Chairperson Compensated	
K-6 (N=216)	51 (69)+	19 (16)	18 (11)	12 (4)
7-12 (N=270)	33 (37)	31 (21)	35 (37)	1 (5)

+ Results of 1977 national survey in ( ).

Table 43

Status Of Department Chairperson By School Size*

School Size	Sample N	Percent of Schools			Missing
		No Chairperson	Chairperson Not Compensated	Chairperson Compensated	
Small		9	27	55	8
Medium		29	30	36	6
Large		46	20	30	4
Missing		25	25	50	0

* Refer to Appendix __ for description of this variable.

CHAPTER 7

Sources Of Information Used By Science Educators

A. Overview

Principals were given a list of possible sources of information about new developments in education. Teachers were given the same list of sources, but were asked to rate each as a source of (1) what topics to teach in science, and (2) how to teach science. The response options for each source of information were: (1) not useful, (2) somewhat useful, and (3) very useful. The percent of principals and teachers rating each source as "very useful" are presented in Table 44; complete data are included in Appendix Tables B.28 to B.32. The perceived utility of each of the sources is discussed separately below.

B. Specific Sources of Information

1. Teachers

Many principals (37 percent) rate teachers as a very useful source of information about new developments in education. Teachers also rate other teachers as a very useful source of information about what topics to teach in science (38 percent) and how to teach science (45 percent). Most of the remaining members of each group rated teachers as "somewhat useful" sources of information.

2. Principals

Over 50 percent of the principals consider other principals to be very useful as sources of information about new developments in education. However, only 2-3 percent of all teachers consider principals to be a very useful source of information about what topics to teach in science or about how to teach science; only about 22 percent of teachers consider principals to be "somewhat useful" as a source of information in these two areas.

3. Local Science Specialists/Coordinators

Forty-eight percent of K-6 principals and 34 percent of the 7-12 principals consider local subject specialists or coordinators to be a very useful source of information about new developments in education. About 19 percent of elementary teachers and only 6 percent of secondary teachers consider local science specialists to be a very useful source of information about what to teach or how to teach. About 39 percent of elementary teachers and 30 percent of secondary teachers consider local science specialists to be a somewhat useful source of information.

4. State Department Personnel

About 17 percent of principals consider state department personnel to be useful sources of information about new developments in education. In contrast, only 4 percent of teachers consider state department personnel to be useful sources of information about what topics to teach in science or about how to teach science.

Table 44

Percent Of Principals And Teachers Indicating
Each Source Of Information As Very Useful

Source of Information	New Developments		What Topics To Teach				How To Teach Science			
	Principals		Teachers				Teachers			
	K-6	7-12	K-3	4-6	7-9	10-12	K-3	4-6	7-9	10-12
Teachers	33	40	39	27	48	37	45	34	52	46
Principals	51	53	2	2	2	1	3	3	3	1
Local Science Specialists/ Coordinators	48	34	24	15	9	5	20	18	7	5
State Department Personnel	18	16	4	5	5	2	3	3	4	1
College Courses	21	13	23	18	38	41	30	27	23	25
Local Inservice Programs	52	37	33	22	15	11	34	29	16	13
Federally Sponsored Workshops	24	15	17	17	32	38	18	17	28	32
Teacher Union Meetings	0	1	0	0	0	1	0	1	1	2
Meetings of Professional Organizations	40	51	4	0	24	26	3	5	19	22
Journals and Other Professional Publications	55	57	17	6	33	47	17	17	25	30
Publishers and Sales Representatives	14	6	7	16	6	5	7	5	3	2
Parents	3	1	4	2	1	3	3	1	0	1
Sample N	216	270	161	179	242	222	161	179	242	222

5. College Courses

Many teachers (between 18 and 41 percent) consider college courses to be very useful sources of information about both what topics to teach and how to teach. Only about 15 percent of the teachers find college courses "not useful." Similarly, 21 percent of elementary school principals and 13 percent of secondary principals consider college courses to be a very useful source of information about new developments in education.

6. Local Inservice Programs

Between 11 and 34 percent of all teachers consider local inservice programs to be very useful sources of information about what science topics to teach and how to teach science. The perceived utility of local inservice programs decreases with increasing grade level (e.g., for what topics to teach, 33, 22, 15, and 11 percent of K-3, 4-6, 7-9, and 10-12 teachers, respectively, consider local inservice programs to be a very useful source of information).

On the other hand, only 5 percent of principals consider local inservice programs to be "not useful" sources of information; 52 percent of elementary school principals and 37 percent of secondary school principals consider local inservice programs to be very useful sources of information about new developments in education.

7. Federally Sponsored Workshops

Almost twice as many secondary science teachers (32 percent) as elementary teachers (17 percent) consider federally sponsored workshops to be a very useful source of information about what to teach and how to teach. Relatively few principals (24 percent elementary, 15 percent secondary) indicated that federally sponsored workshops are a major source of information about new developments in education.

8. Teacher Union Meetings

Neither teachers nor principals consider teacher union meetings a very useful source of information.

9. Meetings of Professional Organizations

Almost half the principals consider meetings of professional organizations to be a very useful source of information about new developments in education. Only 23 percent of secondary teachers indicated that they found meetings of professional organizations to be a very useful source of information; elementary teachers do not consider meetings to be a useful source of information.

10. Journals and Other Professional Publications

Professional publications are considered a very useful source of information by many educators. Over half of the principals consider journals to be a very useful source of information of new developments in education. The percentages of teachers rating journals very useful were lower (17 percent for elementary teachers, and between 25 and 47 percent for secondary science teachers).

Teachers were asked if there were one or two journals or periodicals which they find particularly helpful to them in their work (the question was specific in the selected science class). The results, shown in Table 45, are consistent with the pattern described above. There is an increase in percent finding journals useful with increase in grade range. Table 46 indicates the most commonly used science journals.

Table 45

Percent Of Teachers Who Find One Or More Journals Particularly Helpful, By Grade Range

Use Journal	Grade Range K-3	4-6	7-9	10-12	K-12 Total
Yes	16	17	37	48	31
No	70	70	45	42	
Missing/Inconsistent	14	13	19	10	

Table 46

Most Commonly Used Journals

K-6

Science World
Instructor Magazine
Science and Children
National Geographic World

7-9	7-9 Life	7-9 Earth
Science World The Science Teacher Science Digest	The American Biology Teacher	Sky & Telescope

10-12	10-12 Biology	10-12 Chemistry	10-12 Physics
The Science Teacher Scientific American Science 83 Discover	The American Biology Teacher	American Journal of Chemical Educ.	The Physics Teacher

11. Publishers and Sales Representatives

Relatively few principals (6 to 14 percent) and teachers (from 2 to 16 percent) indicated that publishers and sales representatives are a major source of information about new developments in education, what topics to teach, or how to teach science.

12. Parents

Neither principals nor teachers consider parents a very useful source of information.

CHAPTER 8

Factors Which Affect Instruction In Science Education

A. Overview

Principals and teachers were given a list of "problems" and asked to rate each factor (according to the extent of the problem caused in the school as a whole) as a serious problem, somewhat of a problem, or not a significant problem. The percent of principals and teachers who consider each factor a serious problem are shown in Table 47. Complete data broken down by grade range, science subject, and district strata are included in Appendix Tables B.33 to B.37.

Table 47

Percent Of Principals And Teachers
Indicating That Each Factor Is A Serious
Problem For Science Instruction In Their School

Factor	Principals	Teachers
Belief that science is less important than other subjects	4 (17)+	12 (7)
.....of administrators		9
.....of student counselors		7
.....of teachers		4
Compliance with federal regulations	3 (4)	7 (3)
Inadequate facilities	6 (37)	24 (26)
Insufficient funds for purchasing equipment and supplies	10 (34)	32 (28)
Lack of material for individualizing instruction	10 (25)	30 (29)
Out-of-date teaching materials	5 (14)	15 (13)
Insufficient numbers of textbooks	4 (5)	13 (9)
Lack of student interest in science	5 (14)	15 (9)
Inadequate student reading abilities	3 (20)	12 (24)
Inadequate student mathematical abilities	3	14
Lack of teacher interest in science	7 (14)	6 (4)
Teachers inadequately prepared to teach science	10 (17)	9 (6)
Lack of teacher planning time	8 (14)	32 (18)
Not enough time to teach science	9 (11)	24 (15)
Class sizes too large	7 (12)	39 (15)
Difficulty maintaining discipline	1 (7)	9 (5)
Inadequate articulation of instruction across grade levels	5 (14)	12 (9)
Inadequate diversity of science electives	7 (5)	9 (8)
Low enrollments in science courses	8 (7)	7 (3)
Lack of readily available advice or help for teachers in science instruction	8	20
Sample N	486	804

+ Results of 1977 national survey ( ).

B. General Results

In general, Minnesota Principals tended to perceive each factor as less of a problem than principals in the 1977 National Survey. In fact, none of the factors were considered a serious problem by more than 10 percent of the Minnesota principals, compared to a high of 37 percent of the 1977 National Survey. In contrast, Minnesota teachers tended to perceive the factors as being more serious problems than teachers in the 1977 National Survey. Grade 4-6 teachers perceived the factors as being more serious problems than the other grade range teachers. Also, teachers in districts in Cities of the First Class tended to perceive the factors as more serious problems than teachers in other types of school districts.

The factors perceived by teachers to be the most serious problems include class sizes too large, lack of teacher planning time, insufficient funds for purchasing equipment and supplies, and lack of material for individualizing instruction. The perceived seriousness of each factor is discussed separately below. In this discussion, reference is often made to the "ranking" of a problem rather than to the percent labeling a factor as a "serious problem." It should be emphasized that respondents were not asked to rank the factors; rather the ranking was based on the percentage in each group rating each factor as a serious problem.

C. Specific Factors That Affect Science Instruction

1. The belief that science is less important than other subjects is more of a problem in elementary schools than in secondary schools; 59 percent of elementary teachers and 46 percent of secondary teachers consider this factor to be somewhat of a problem or a serious problem. Similarly, 54 percent of elementary school principals and only 9 percent of secondary school principals consider this factor to be somewhat of a problem or a serious problem.

   When considering specifically the belief of administrators, student counselors, or teachers that science is less important than other subjects, the percentages dropped somewhat. It is interesting that more than 97 percent of the secondary school principals consider the belief of student counselors that Science is less important than other subjects to be "somewhat of a problem."

2. Compliance with Federal Regulations is not considered to be a major problem by principals or teachers.

3. Inadequate facilities is considered to be a serious problem by about one-fourth of the teachers, giving it a rank of 5.5 among the 23 possible problems. 4-6 teachers are more likely to rate inadequate facilities as a serious problem (35 percent) than K-3 teachers (24 percent), 7-9 teachers (22 percent), or 10-12 teachers (17 percent). Similarly, 52 percent of elementary principals and only 27 percent of secondary principals rate inadequate facilities to be somewhat of a problem or a serious problem

4. Insufficient funds for purchasing equipment and supplies is considered a serious problem by 32 percent of the teachers, giving it a rank of 2.5 among the 23 possible problems. Principals considered this a major problem as well.

5. Lack of materials for individualizing science instruction is considered a serious problem by 30 percent of the science teachers, giving this factor a rank of 4 among the 23 possible problems. Principals also considered this a major problem area.

6. Out-of-date teaching materials do not cause a major problem for teachers; only 15 percent rate this is a serious problem (although, again, 4-6 teachers are more likely to rate this a serious problem (23 percent) than K-3 (17 percent), 7-9 (12 percent), and 10-12 (11 percent) teachers). Similarly, principals do not rate this as a major problem area.

7. Insufficient numbers of textbooks is considered a serious problem by one-fourth of 4-6 teachers; K-3 teachers (12 percent), 7-9 teachers (12 percent); 10-12 teachers (7 percent), and principals (4 percent) do not consider this factor to be a major problem.

8. Lack of student interest in science appears to be more of a problem in grades 7-12 than in grades K-6. While fewer than 5 percent of the K-6 teachers rated lack of student interest in science as a serious problem, approximately one-fourth of the 7-12 teachers considered and to be a serious problem in their schools. Similarly, only 33 percent of the elementary school principals rated this factor as somewhat of a problem or a serious problem, while 50 percent of the secondary school principals considered lack of student interest to be somewhat of a problem or a serious problem.

9. Inadequate student reading ability does not cause a serious problem for teachers, although secondary teachers are more likely to rate this as a serious problem than elementary teachers (16 percent and 7 percent, respectively). Curiously, secondary school principals rank this factor highest (1) among the 23 problems (60 percent considered inadequate student reading abilities to be somewhat of a problem or a serious problem).

10. Inadequate student mathematical abilities is considered to be a serious problem by 22 percent of secondary science teachers and by only 4 percent of elementary teachers. Again, secondary school principals rank this factor 2nd among the 23 problems (51 percent considered inadequate student mathematical abilities to be somewhat of a problem or a serious problem).

11. Lack of teacher interest in science is not considered to be a major problem in their schools by teachers or by secondary school principals. However, elementary principals consider this to be a major problem (13 percent rating this factor as a serious problem and 55 percent giving it a rating of somewhat of a problem).

12. Teachers inadequately prepared to teach science is not considered a major problem by teachers or by secondary school principals. However, elementary school principals rank this factor the highest (1) among the 23 problems (19 percent consider inadequate teacher preparation to be a serious problem, and 55 percent rate it as somewhat of a problem).

13. Lack of teacher planning time is considered to be a serious problem by 32 percent of teachers, giving it an overall rank of 2.5 among the 23 problems. Moreover, elementary teachers are about twice as likely to consider this factor a serious problem than secondary teachers; 47 percent of K-6 teachers and only 21 percent of 7-12 teachers consider lack of teacher planning time to be a serious problem. Similarly, 55 percent of elementary school principals and only 24 percent of secondary school principals consider this factor to be somewhat of a problem or a serious problem.

14. Inadequate time to teach science is considered a serious problem in the lower grades; 32 percent of K-3 teachers, 29 percent of 4-6 teachers and 15 percent of elementary school principals rate this factor as a serious problem. It is less of a problem in the higher grades; 19 percent of 7-9 teachers, 18 percent of 10-12 teachers, and only 3 percent of the secondary school principals consider inadequate time to teach science to be a serious problem.

15. Large class sizes is ranked as the most serious problem by teachers, with 39 percent rating this factor as a "serious problem." This perception is not shared by the principals, who do not consider large class sizes a serious problem.

16. Difficulty in maintaining discipline is not considered a serious problem by teachers (9 percent) or by principals (1 percent), except for teachers in districts in Cities of the First Class (20 percent).

17. Inadequate articulation of instruction across grade levels is not considered a serious problem by teachers (12 percent) or by principals (5 percent).

18. Inadequate diversity of science electives is not rated as a serious problem by teachers (9 percent) or by principals (7 percent).

19. Low enrollments in science courses is not considered to be a serious problem by teachers (7 percent) or by principals (8 percent).

20. Lack of readily available advice or help for teachers in science instruction is considered a major problem for K-6 teachers and principals; 29 percent of the elementary teachers and 12 percent of the elementary school principals rates this factor as a "serious problem," giving it a rank of 5-7 among the 23 problems. Secondary school teachers and principals do not consider this factor to be a major problem area.

CHAPTER 9

The Use of Computers in Science Instruction

A. Overview

Principals and teachers were asked if computer terminals or microcomputers were available in their schools for teacher use, and if so, how many were available. Teachers were asked whether they actually used a computer in their science teaching, and if so, for what kind of activities and how often. In addition, teachers were given a list of potential "barriers" to the use of computers in science instruction and asked to rate the seriousness of these problems. The results are presented in the following sections.

B. Availability of Computers

Principals and teachers were asked if a computer terminal or microcomputer was available in their school for teacher use and, if so, how many. The results are shown in Tables 48 and 49. Teacher data broken down by district strata are included in Appendix B.38. Only 10 percent of the teachers and 4 percent of the principals report that a computer terminal or microcomputer is not available in their school. About one-quarter of the teachers report one computer available for their use, 14 percent report two computers, 24 percent report three to six computers, and 17 percent report more than six computers are available for their use. In general, principals report a larger number of available computers than teachers. Either the teachers are not aware of the number of computers available for their use, or some of the computers in the school are not generally available to the teacher (for example, the computers could be in a special computer laboratory or only available to mathematics, computer science, or business teachers).

Table 48

Percent Of Principals And Teachers Who
Report That A Computer Is Available In
Their School For Teacher Use, By Grade Range

	Principals		Teachers			
Computer In School	K-6	7-12	K-3	4-6	7-9	10-12
Yes	95	98	78	85	82	89
No	5	2	15	12	7	7
Missing	0	0	7	3	12	5
Sample N	216	270	161	179	242	222

Table 49

Percent Of Principals And Teachers
Who Report Various Numbers Of Computers
Available For Teacher Use, By Grade Range

Number of Available Computers	Principals		Teachers			
	K-6	7-12	K-3	4-6	7-9	10-12
None	5	3	15	12	7	7
One	4	2	26	27	20	25
Two	16	6	17	16	12	11
Three to six	43	30	23	28	24	23
Seven to ten	14	20	8	7	8	13
More than ten	17	39	3	6	12	10
Missing/Inconsistent	0	0	8	5	17	11
Sample N	216	270	161	179	242	222

Table 50 shows how often computers are available to teachers. The pattern of availability seems to be daily (17 percent), once a week (12 percent), or once a month (20 percent). As indicated on Table 51, this pattern is independent of the number of computers available for teachers to use. Note that a large percentage of teachers (29 percent) did not respond to the question of how often a computer terminal or microcomputer is available for their use. There is some indication from written messages on the questionnaires that the computers in some schools are only available for use by mathematics, computer science, or business teachers.

Table 50

Frequency Of Availability Of Computers, By Grade Range

How often computers available	Percent of Teachers				K-12 Total
	K-3	4-6	7-9	10-12	
Daily	15	16	15	22	17
Twice a week	4	11	3	4	5
Once a week	14	17	6	14	12
Once every two weeks	4	6	5	5	5
Once every three weeks	2	3	3	2	2
Once a month	17	16	29	20	20
Do Not Have Computer	15	12	7	7	10
Missing/Inconsistent	32	18	32	26	29
Sample N	161	179	242	222	804

Table 51

Frequency Of Availability Of Computers By
Number Of Computers In The School* (N=633)

Number of Computers	How Often Computers Available: Daily	Twice a Week	Once a Week	Once in 2 Weeks	Once in 3 Weeks	Once a Month	Missing
1	25	3	17	2	3	26	25
2	16	9	14	9	2	31	14
3-6	22	9	13	8	4	26	18
7-10	21	7	25	4	3	22	19
more than 10	19	6	11	12	3	26	23

* Only teachers who reported the number of computers available in their school are included in this analysis.

C. How Computers are Used in Science Instruction

Teachers were asked if they used a computer in their science instruction, and, if so, for what purpose. The results are shown in Tables 52 and 53. Computer usage in science teaching increases with increasing grade level, from 16 percent in grades K-3, 34 percent in grades 4-6 and 7-9, to 40 percent in grades 10-12. Teachers tend to use the computer primarily for enrichment activities for some students (72 percent). About 40 percent of the teachers use the computer for instruction of all students (42 percent), while only 18 percent use the computer for remedial activities for some students. Elementary teachers are more likely than secondary teachers to use the computer for enrichment activities and less likely to use the computer for instruction of all students.

Table 52

Percent Of Teachers Who Use A Computer
In Their Science Teaching, By Grade Range

Computer Used in Science Teaching	Grade Range: K-3	4-6	7-9	10-12	K-12 Total
Computer Not Available	15	12	7	7	10
Use in Science Teaching	16	34	34	40	32
Do not use in science teaching	0	1	3	1	1
Missing	69	53	57	52	57
Sample N	161	179	242	222	804

Table 53

Percent Of Teachers Who Use The Computer
For Different Purposes, By Grade Range*

Purpose	Percent of Teachers K-3	4-6	7-9	10-12	K-12 Total
Enrichment Activities for some	96+	86	65	64	72
Remedial Activities for some	8	19	19	20	18
Instruction of all students	27	31	46	50	42
Sample N	26	60	82	89	257

* Only those teachers who said they use computers in their teaching of science are included in this analysis.

+ Since teachers could indicate more than one purpose, percentages do not add up to 100%.

Table 54 shows the frequency of use of various types of computer activities. In general, the computer is used less than once-a-month, primarily for simulated laboratory experiences, games, tutorials, and drill and practice. Very few teachers use the computer for classroom management, testing, analyzing class data, or collecting data by interfacing the computer to the science equipment.

Table 54

Frequency Of Use Of Various Computer Activities In Science Classes* (N=257)

Computer Activity	Frequency Of Use: Never	Less Than Once a Month	At Least Once a Month	At Least Once a Week	Just About Daily	Missing
Classroom management (recordkeeping, generating tests, etc.)	82	6	4	5	2	2
Games	46	36	12	5	0	2
Simulated laboratory experiments	47	42	7	2	0	2
Tutorial (teach new concepts)	53	30	12	2	0	3
Drill and Practice	47	30	15	5	1	3
Testing (students take test on computer)	88	7	3	0	0	3
Analyzing class data	77	16	4	1	0	2
Collecting data by interfacing computer to science equipment	89	7	1	0	0	3
Other	10	2	2	1	0	84

* Only those teachers who said they use computers in their teaching of science are included in this analysis.

The types of computer activities used by science teachers could depend on the software available for their use. Teachers were asked to indicate the source of the computer software they used in their science teaching. The results are shown in Table 55. The primary source of science computer software is the Minnesota Educational Computing Consortium (MECC); 70 percent of the teachers use MECC software. Thirty-seven percent of the teachers use software produced by computer companies, and about one-fourth of the teachers use software from publishers, from other teachers' programs, and their own programs. Grade 10-12 teachers are more likely to use their own programs (37 percent) than 7-9 teachers (17 percent), 4-6 teachers (15 percent), or K-3 teachers (0 percent).

Table 55

Percent+ Of Teachers Using Various Sources Of Science Computer Software, By Grade Range*

Source of Science Computer Software	Grade Range K-3	4-6	7-9	10-12	K-12 Total
Minnesota Educational Computing Consortium	77	77	66	67	70
Publishers	4	23	28	25	23
Other teacher's programs	19	25	22	25	23
My own programs	0	15	17	37	22
Materials produced by computer companies	27	43	34	37	37
Other	12	5	4	6	5
Missing	0	0	2	0	1
Sample N	26	60	82	89	257

* Only those teachers who said they use computers in their teaching of science are included in this analysis.

+ Since teachers could indicate more than one source of software, percentages do not add up to 100%.

D. Factors Which Affect the Use of Computers in Science Instruction

Principals and teachers were given a list of sixteen "problems" which could affect the use of computers in science instruction and asked to rate each factor (according to the extent of the problem caused in the school as a whole) as a serious problem, somewhat of a problem, or not a significant problem. The percent of principals and teachers who consider each factor a serious problem are shown in Table 56. Complete data by grade range, science subject, and district strata are included in Appendix Tables B.39 to B.43.

Table 56

Percent Of Principals And Teachers Indicating That Each Factor Is A Serious Problem For The Use Of Computers In Science Teaching, By Grade Range

Factor	Principals		Teachers	
	K-6	7-12	K-6	7-12
Belief of administration that computers are not a useful tool	5	3	1	3
Belief of teachers that computers are not a useful tool	6	5	2	6
Insufficient numbers of terminals or microcomputers	26	17	50	49
Lack of technical support for maintenance and repair of terminals or microcomputers	12	10	26	20
Inconvenient location of terminals or microcomputers	13	8	36	41
Lack of student interest in computers	4	3	1	3
Inadequate student cognitive abilities	6	5	3	13
Lack of teacher comfort in using computers	26	18	25	32
Lack of teacher training in how to incorporate computers into science teaching	39	22	47	54
Lack of teacher interest in using computers	13	9	9	15
Lack of continuing assistance in the use of computers in science teaching	26	16	31	34
Lack of teacher training in computer programming	41	24	46	51
Inadequate number of science software programs	39	23	51	47
Inappropriate software topics for our science curriculum	36	20	51	43
Low quality of available science software	33	19	36	35
Not enough time to use computers in science teaching	30	17	49	47
Sample N	216	242	340	464

In general, principals and teachers perceived the same factors to be a serious problem, although teachers tended to perceive the factors as more of a problem than the principals. Elementary school principals tended to perceive factors as more problematic than secondary school principals. The factors perceived by about half of the teachers to be the most serious problems include:

- insufficient numbers of terminals or microcomputers.
- lack of teacher training in how to incorporate computers into science teaching;
- lack of teacher training in computer programming;
- inadequate number of science software programs;
- inappropriate software topics for our science curriculum;
- not enough time to use computers in science teaching.

In addition, about 30 to 40 percent of the teachers considered the following factors to be serious problems:

- inconvenient location of terminals or microcomputers;
- lack of teacher comfort in using computers;
- lack of continuing assistance in the use of computers in science teaching;
- low quality of available science software.

There were few significant differences by grade range, science subject, or district strata.

These results are consistent with the data on teachers' needs for additional assistance; about two-thirds of the teachers reported that they need additional assistance in obtaining information about how to use computers in their science instruction, training in computer programming, obtaining information about available science computer software, and readily available day-to-day help in the classroom use of computers.

APPENDIX A

Description of Reporting Variables

1. District Strata

Each sample teacher was classified as belonging to one of five school district strata, as follows:

Cities of the First Class - districts in Minneapolis, St. Paul, and Duluth;

Seven County Metro Suburbs - districts in the seven county metropolitan suburbs of the Twin Cities;

More than 2000 students - districts outside the Twin Cities metropolitan area which enroll more than 2000 students;

1000-1999 students - districts outside the Twin Cities metropolitan area which enroll between 1000 and 1999 students;

0-999 students - districts outside the Twin Cities metropolitan area which enroll less than 1000 students.

2. Grade Range

Most results for teachers are reported by grade range -- K-3, 4-6, 7-9, or 10-12. The grade range sample broken down by district strata is shown in Table A.1. As expected, the smallest samples were of elementary teachers; more secondary than elementary teachers filled out and returned the questionnaires. Consequently, for many questions combining results across grade ranges may result in a slight secondary teacher bias. At each grade level, the percentage of teachers in each type of district is very close to the state distribution of students within district types. Consequently, combining questionnaire results across district types should result in appropriate state estimates.

Most results for principals are repoted by the grade ranges K-6 and 7-12. It is important to note that the definitions of these levels are not mutually exclusive. For example, all schools with any of the grades K-3 were eligible for selection into the K-3 sample. Many of these schools also contain one or more of the grades 4-6, 7-9, or even 10-12, so they were often eligible for selection into these samples. In Minnesota, K-12 schools are required to have both an elementary and a secondary principal. If the same school was chosen for two different grade ranges (K-6 and 7-12), both principals were sent a questionnaire. However, when principals answered questions about their schools, they answered for the school as a whole (elementary or secondary) and not for any particular grade range. Consequently, for many questions, combining results across grade ranges may result in overestimates.

Table A.1

Percent of Teachers in Each Grade Range,
By Type of District

District Strata	Percent in Grade Range K-3	4-6	7-9	10-12	K-12 Total
Cities of the First Class (12)*	14	12	9	12	11
Seven Cty Metro Suburbs (37)	41	39	45	34	40
More than 2000 Students (22)	20	19	20	23	21
1000-1999 Students (12)	11	12	12	12	12
0-999 Students (19)	13	17	14	20	16
Missing	1	0	0	0	0
Sample N	161	179	242	222	804

* Percent of Minnesota students enrolled in each type of district.

3. Science Subject

Many of the results for 7-12 teachers were reported by science subject, as follows:

7-9 Life Science
7-9 Earth Science
7-9 Physical Science

10-12 Biology
10-12 Chemistry
10-12 Physics

Table A.2 shows the percentage of sample 7-12 teachers broken down by grade range and science subject. Since science subjects were not randomly selected, care should be taken in interpreting grade range data as representative of all 7-9 or 10-12 teachers in the state. Moreover, this survey does not include any data about class size, percentage of female students, ratings of facilities, equipment, and supplies, instructional techniques, textbook usage, or computer usage for any of the other science subjects taught at the secondary school level. Thus, care should be taken in comparing Minnesota results to the results of the 1977 National Survey, which randomly sampled science subjects*.

* In the 1977 National Survey, however, 74 percent of the 10-12 teachers surveyed reported on Biology, Chemistry, and Physics classes, and 56 percent of the 7-9 teachers reported on Life Science, Earth Science, and Physical Science classes.

Table A.2

Percent Of Teachers By Grade Range And Science Subject

	Percent of Teachers
7-9 Science	
Life Science (N=71)	29
Earth Science (N=79)	33
Physical Science (N=84)	35
Missing (N=8)	3
	100
10-12 Science	
Biology (N=82)	37
Chemistry (N=72)	32
Physics (N=68)	31
Missing (N=0)	0
	100

The six science subjects chosen for this survey are not mutually exclusive classifications. For example, all teachers who taught at least one section of a science subject were eligible for selection into that sample. Some teachers teach more than one science subject, so they were eligible for selection into more than one science subject sample. Consequently, for questions about science instruction in the school as a whole, combining results across science subjects may result in slight overestimates. Also, it should be noted that the sample sizes were small (68 to 84), so the standard errors are larger for science subject comparisons than for grade level comparisons.

4. Type of Community

Each principal was asked to choose the category which best described the location of the school from among the following:

1. A rural or farming community;
2. A small city or town of fewer than 50,000 people that is not a suburb of a larger place;
3. A medium-sized city (50,000-100,000 people);
4. A suburb of a medium-sized city;
5. A large city (100,000-500,000 people);
6. A suburb of a large city;
7. A very large city (over 500,000 people); and
8. A suburb of a very large city.

These 8 response categories were collapsed into 4 types of community levels as follows:

Type of Community

1 -- Rural
2 -- Small City
3, 5, 7 -- Urban
4, 6, 8 -- Suburban

School type of community was used for several school analyses.

5. Size of School

Principals were asked to provide the total enrollment in their schools as well as the enrollment in each grade and the number of "special" students. Total enrollment was used to categorize each school as small, medium, or large, but as shown below the definitions were dependent on the sample grade range of the school.

K-6
Size of School

Small -- Less than 377 students
Medium -- 378-581 students
Large -- More than 581 students

7-12
Size of School

Small -- Less than 516 students
Medium -- 517-971 students
Large -- More than 972 students

The average total school enrollment broken down by type of community and sample grade range is shown in Table A.3. As expected, average total enrollment increases with sample grade range. In addition, schools in urban and suburban types of communities tend to have larger enrollments.

A.3

Average School Total Enrollment By
Type of Community and Grade Range

Type of Community	K-6	7-12
Rural	387	469
Small City	500	877
Urban	503	1,077
Suburban	554	1,283
Unknown	--	--
Sample N	216	270

6. Percent of Students in Free Lunch Program

Each principal was asked to indicate the number of students in the school who qualify for the Federal free lunch program. Total enrollment was then used in conjunction with this figure to classify each school into one of the following categories:

Students in Free Lunch Program

Less than 10%
10-30%
More than 30%

Table A.4 shows the breakdown of the sample of elementary and secondary principals by type of community, size of school, and percent of students in free lunch program.

A.4

Principal Sample Sizes By Classification Variables

	Grade Range K-6	Grade Range 7-9
Type of Community		
Rural	74	118
Small City	50	56
Urban	15	22
Suburban	70	73
Missing	7	1
Size of School		
Small	67	87
Medium	68	87
Large	66	87
Missing	15	9
Students in Free Lunch Program		
Less Than 10%	50	69
10-30%	75	94
More Than 30%	27	25
Missing	64	82
Total Sample Size	216	270

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Table B.1

Average Class Size By District Strata And Grade Range

Strata	Average Class Size K-3	4-6	7-9	10-12	K-12 Total
Cities of the first class	26.1 (1.40)+	27.1 (0.82)	29.3 (0.72)	24.3 (1.12)	26.6 (0.55)
7-county metro suburbs	25.5 (0.47)	27.7 (0.39)	27.9 (0.41)	27.3 (0.49)	27.2 (0.22)
More than 2000 students	24.3 (0.41)	26.8 (0.62)	27.3 (0.49)	23.4 (0.70)	25.3 (0.33)
1000 to 1999 students	24.6 (1.00)	23.1 (0.54)	23.1 (0.91)	20.7 (1.34)	22.7 (0.52)
0 to 999 students	22.1 (1.11)	21.8 (1.02)	24.6 (1.30)	19.3 (1.18)	21.7 (0.62)
Sample N	149	172	201	198	720

+ Standard error in ( ).

Table B.2
Elementary Teachers' Frequency Of Use Of Different Science Textbooks/Programs

Textbook/Program	Publisher	Never Used	Used Occassionally	Used Frequently	The One Used Most Often
Essence I	Addison-Wesley	99	1	0	0
STEM: Elementary School Science	Addison-Wesley	91	2	1	6
Investigating in Science (Jacobson)	American Book	97	2	1	0
Exploring and Understanding Series	Benefic Press	99	1	0	0
Minnemast Units	Edutech Products	97	2	1	0
Ginn Science Program (Atkin)	Ginn	95	1	1	3
Science: A Process Approach (SAPA)	Ginn	96	2	1	1
Science: A Process Approach (SAPA II)	Ginn	98	1	1	0
Concepts in Science (Brandwein)	Harcourt, Brace, Jovanovich	81	5	1	13
Today's Basic Science Series (Navarra)	Harper & Row	96	2	2	0
Health Science Series (Schneider)	D.C. Heath	95	2	1	2
Modern Elementary Science (Fischler)	Holt, Rinehart, & Winston	94	3	0	3
Measurement, Concepts, & Applications	Houghtin Mifflin	99	1	0	0
New Laidlaw Science Program	Laidlaw	96	2	0	2
Nuffield Science Program	MacDonald Education	99	1	0	0
Science For Tomorrow's World (Barnard)	MacMillan	99	1	0	0
Elementary Science Study Program (ESS)	McGraw Hill	86	4	5	5
Gateways to Science (Holmes)	McGraw Hill	97	2	0	1
Accent on Science (Sund)	Merrill	88	1	1	10
Discovering Science Series (Piltz)	Merrill	98	1	0	1
Elementary Science: Learning by Investigating (ESLI)	Rand McNally	97	1	1	I
Science Curriculum Improvement Study (SCIS): Life Science	Rand McNally	83	3	4	10
Science Curriculum Improvement Study (SCIS): Physical Science	Rand McNally	86	4	3	7
Science: Understanding Your Environment (Mallison)	Silver Burdett	82	2	2	14
Elementary Science (Abruscato)	Holt, Rinehart, & Winston	99	0	0	1
Elementary Science (Bendick)	Ginn	99	0	0	1

Table B.3
7-9 Life Science Teachers' Frequency Of Use Of Different Textbooks/Programs

Textbook/Program	Publisher	Never Used	Used Occassionally	Used Frequently	The One Used Most Often
Exploring Life Science (Thurber)	Allyn & Bacon	92	6	2	0
Life Science: A Problem Solving Approach (Carter)	Ginn	86	2	3	9
Biological Science (Gregory)	Ginn	98	2	0	0
Cambridge Work-a-Text: Life Science (Perkins)	Globe Book	98	0	2	0
Human Biology	Golden Book	98	2	0	0
Life: Its Forms and Changes	Harcourt, Brace, Jovanovich	92	6	2	0
Life: A Biological Science (Curie Edition)	Harcourt, Brace, Jovanovich	98	0	2	0
The Earth: It's A Living Thing	Harcourt, Brace, Jovanovich	95	3	2	0
Life Science (Ramsey)	Holt	81	3	0	16
Modern Life Science (Ramsey)	Holt	93	2	2	3
Living Things (Fitzpatrick)	Holt	84	3	2	11
Modern Biology (Otto)	Holt	95	5	0	0
Exploring Living Things	Laidlaw	92	0	0	8
Biological Sciences	Laidlaw	98	0	2	0
Life Science: A Search for Understanding (Brown)	J.B. Lippincott	98	2	0	0
Challenges to Science Series: Life Science (Smallwood)	McGraw Hill	95	2	3	0
Focus on Life Science (Heimler)	Merrill	63	3	3	31
Life Science: A Learning Strategy for the Laboratory (Kaskel)	Merrill	98	2	0	0
Principles of Science	Merrill	0	0	0	2
Ideas and Investigations in Science: Life Science (Wong)	Prentice-Hall	87	5	5	3
Life Science (Webster)	Prentice-Hall	95	0	0	5
Interaction of Man and the Biosphere: Inquiry in Life Science (Abraham)	Rand McNally	87	9	2	2
Biological Science: An Ecological Approach (BSCS Green)	Rand McNally	98	2	0	0
Life Science (Balzer)	Scott-Forsman	98	0	0	2
Life Science (Richardson)	Silver Burdett	98	2	0	2
Why You're You	Silver Burdett	98	0	2	0

Table B.4
7-9 Earth Science Teachers' Frequency Of Use Of Different Textbooks/Programs

Textbook/Program	Publisher	Never Used	Used Occassionally	Used Frequently	The One Used Most Often
Earth Science: A Laboratory Approach (Marean)	Addison-Wesley	96	3	1	0
Exploring Earth Science (Thurber)	Allyn & Bacon	91	6	3	0
Earth Science: The World We Live In (Namowitz)	American Book	74	11	4	10
Pathways in Science: Earth Science (Oxenhorn)	Globe Book	94	6	0	0
Cambridge Work-a-Text: Earth Science	Globe Book	99	0	0	1
Matter: An Earth Science (Curie Edition)	Harcourt, Brace, Jovanovich	96	3	1	0
Matter: It's Forms and Changes	Harcourt, Brace, Jovanovich	99	1	0	0
Our Planet in Space: The Earth Sciences (Navarra)	Harper & Row	96	4	0	0
Earth and Space Science (Wolfe)	D.C. Heath	99	1	0	0
Earth Science (Ramsey)	Holt, Rinehart, & Winston	86	0	0	14*
Modern Earth Science (Ramsey)	Holt, Rinehart, & Winston	44	13	14	29*
ESCP Pamphlet Series (Boyer)	Houghton Mifflin	93	7	0	0
Investigating the Earth (ESCP)	Houghton Mifflin	76	17	4	3
Spaceship Earth: Earth Science (Jackson)	Houghton Mifflin	91	7	1	0
Exploring Earth and Space	Laidlaw	99	0	0	1
The Physical Sciences (Fisk)	Laidlaw	99	0	1	0
Experiences in Earth Science	Laidlaw	99	0	0	1
Earth Science: A Search for Understanding (Braun)	J.B. Lippincott	97	1	1	0
Challenges to Science Series: Earth Science (Heller)	McGraw Hill	90	6	1	3
Time, Space, and Matter (TSM)	McGraw Hill	96	4	0	0
Focus on Earth Science (Bishop)	Merrill	70	3	3	24
Earth Science: Patterns in Our Environment (Bisque)	Prentice-Hall	97	3	0	0
Earth Science: (Coble)	Prentice-Hall	94	0	3	3
Interaction of Earth and Time: Inquiry In Earth Science (Abraham)	Rand McNally	97	3	0	0
Earth Science	Scott Forsman	99	0	0	1
Earth Science (Brown)	Silver Burdett	97	3	0	0
Introduction to Geology (Stokes)		99	1	0	0
General Geology (Foster)		99	1	0	0
Physical Geology (Hamblin)		99	1	0	0

Table B.5
7-9 Physical Science Teachers' Frequency Of Use Of Different Textbooks/Programs

Textbook/Program	Publisher	Never Used	Used Occassionally	Used Frequently	The One Used Most Often
Physical Science: A Laboratory Approach (Marean)	Addison-Wesley	99	0	1	0
Exploring Physical Science (Thurber)	Allyn & Bacon	96	3	1	0
Inquiry Into Physical Science (Jacobson)	American Book	99	0	1	0
Physical Science: A Problem Solving Approach	Ginn	89	8	0	3
Energy: A Physical Science	Harcourt, Brace, Jovanovich	92	0	1	7
Energy and the Atom: The Physical Sciences (Navarra	Row	99	0	0	1
Physical Science	Holt, Rinehart, & Winston	96	0	0	4
Modern Physical Science (Tracy)	Holt, Rinehart, & Winston	72	12	1	15*
Modern Science: Forces, Change, and Universe (Blanc)	Holt, Rinehart, & Winston	99	0	0	1
Spaceship Earth: Physical Science (Hill)	Houghton Mifflin	97	1	0	1
Exploring Matter & Energy	Laidlaw	98	0	1	1
The Physical Sciences (Fisk)	Laidlaw	97	3	0	0
Challenges to Science Series: General Science	McGraw Hill	99	0	0	1
Focus on Physical Science (Heimler)	Merrill	74	8	6	12*
Principles of Science, Book II	Merrill	99	0	0	1
Ideas and Investigations in Science: Physical Science (Dolmatz)	Prentice-Hall	95	5	0	0
Introductory Physical Science (IPS) (Haber-Schaim)	Prentice-Hall	54	15	4	27*
Physical Science II (PS II) (Haber-Schaim)	Prentice-Hall	99	1	0	0
Physical Science (Appenbrink)	Prentice-Hall	96	1	0	3
Physical Science: An Introductory Study (Andrews)	Prentice-Hall	99	0	0	1
Interaction of Matter & Energy: Inquiry in Physical Sciences (Abraham)	Rand McNally	98	1	0	1
Physical Science (Alexander)	Scott-Forsman	99	1	0	0
Energy, Matter, and Change	Scott-Forsman	99	1	0	0
Physical Science (Barman, Rusch)	Silver Burdett	97	0	0	3
Probing the Natural World (ISCS) (Burkman)	Silver Burdett	96	0	1	3
Concepts and Challenges in Physical Science	Cebco Standard	97	0	0	3

Table B.6
10-12 Biology Teachers' Frequency Of Use Of Different Textbooks/Programs

Textbook/Program	Publisher	Never Used	Used Occassionally	Used Frequently	The One Used Most Often
Biology: Introduction to Life (Nason)	Addison-Wesley	97	3	0	0
Biology (Kimball)	Addison-Wesley	99	1	0	0
Action Biology (Weinberg)	Allyn & Bacon	93	5	1	0
Biology: An Inquiry Into the Nature of Life (Weinberg)	Allyn & Bacon	89	8	3	0
Patterns of Life (Schwartz)	American Book	99	1	0	0
Fundamental Concepts of Modern Biology (Haskel)	Amsco School Pub.	99	0	1	0
Human Anatomy and Physiology	W.C.Brown	99	0	0	1
Concepts in Modern Biology (Kraus)	Cambridge Cook	97	3	0	0
Biology: The Study of Life (Schraer)	Cebco/Standard	99	1	0	0
EMI Programmed Biology Series	Educational Methods	97	3	0	0
Biological Science (Gregory)	Ginn	98	1	0	1
Pathways in Biology (Oxenhorn)	Globe Book	99	0	1	0
Biological Science: An Inquiry Into Life Science (BSCS Yellow) (Moore)	Harcourt, Brace, Jovanovich	83	11	3	4
Biology: Patterns in the Environment	Harcourt, Brace, Jovanovich	99	0	1	0
Exploring Biology (Smith)	Harcourt, Brace, Jovanovich	99	0	0	1
Life (Simpson)	Harcourt, Brace, Jovanovich	99	1	0	0
Biology: You & Your Environment (Cunningham)	D.C. Heath	99	0	0	1
BSCS Laboratory Blocks	D.C. Heath	91	9	0	0
Biological Science: Invitations to Discovery (BSCS)	Holt, Rinehart, & Winston	93	4	3	0
Biological Science: Patterns and Processes (BSCS)	Holt, Rinehart, & Winston	92	7	0	1
Human Physiology	Holt, Rinehart, & Winston	99	0	1	0
Modern Biology (Otto)	Holt, Rinehart, & Winston	29	17	12	42*
Modern Life Science (Ramsey)	Holt, Rinehart, & Winston	99	0	1	0
Biological Science: Molecules to Man (BSCS Blue)	Houghton Mifflin	82	13	3	3
Experiences in Biology (Bauer)	Laidlaw	99	0	1	0
Elements of Biology (Weisz)	McGraw Hill	99	0	0	1
Science of Biology (Weisz)	McGraw Hill	96	1	3	0

Table B.6 (Continued)

Textbook/Program	Publisher	Never Used	Used Occassionally	Used Frequently	The One Used Most Often
Biology: Living Systems (Oram)	Merrill	77	7	3	13*
Focus on Life Science (Heimler)	Merrill	99	0	0	1
Biological Science: Interaction of Experiments & Ideas (BSCS)	Prentice-Hall	91	9	0	0
Biology & Human Processes (Eisman)	Prentice-Hall	96	4	0	0
Ideas and Investigations in Science: Biology (Wong)	Prentice-Hall	94	5	1	0
Biological Science: An Ecological Approach (BSCS Green)	Rand McNally	62	21	4	13*
Biology: A Functional Approach (Roberts)	Ronald Press	99	0	1	0
Biology (Villec)	W.B. Saunders	96	3	1	0
Biology	Scott-Forsman	96	0	0	4
Biology (Smallwood)	Silver Burdett	85	5	5	5

Table B.7
10-12 Chemistry Teachers' Frequency Of Use Of Different Textbooks/Programs

Textbook/Program	Publisher	Never Used	Used Occassionally	Used Frequently	The One Used Most Often
Inquiries in Chemistry (Turner)	Allyn & Bacon	99	0	1	0
General Chemistry: A Laboratory Approach (Benz)	P.S. Amidon	94	0	1	3
Concepts in Modern Chemistry (Kavanah)	Cambridge Book	99	0	0	1
Chemistry, Man, & Environmental Change	Canfield Book	99	1	0	0
Unified Chemistry (Dorin)	Cebco/Standard	98	0	1	1
Discovery Problems in Chemistry (Eckert)	College Entrance Book	98	1	1	0
Modern Road to Chemistry	College Entrance Book	99	1	0	0
Chemistry: An Experimental Science (Pimentel)	W.H. Freeman	91	6	3	0
Concepts in Chemistry (Greenstone)	Harcourt, Brace, Jovanovich	96	3	0	1
Interdisciplinary Approaches to Chemistry (IAC)	Harper & Row	81	7	7	4
Chemistry: Experiments & Principles (CHEM STUDY) (O'Connor)	D.C. Heath	75	7	3	15*
Action Chemistry (Bolton)	Holt, Rinehart, & Winston	87	6	6	1
Chemistry (Masterton)	Holt, Rinehart, & Winston	95	4	0	1
Foundations of Chemistry (Toon)	Holt, Rinehart, & Winston	94	6	0	0
Modern Chemistry (Metcalfe)	Holt, Rinehart, & Winston	48	9	4	39*
Chemistry: An Investigative Approach (Colton)	Houghton Mifflin	99	1	0	0
Chemistry (Quagliano)	McGraw Hill	99	1	0	0
Chemistry (Sienko)	McGraw Hill	94	6	0	0
Chemistry: A Modern Course (Smoot)	Merrill	81	9	1	9*
Basic Chemistry (Seese)	Prentice-Hall	99	0	0	1
Chemistry: Experimental Foundations (Parry)	Prentice-Hall	90	3	1	6
Introduction to Experimental Chemistry (Messer)	Prentice-Hall	99	1	0	0
Problem Solving in Chemistry (Tilbury)	Rand McNally	97	1	1	1
Chemistry of Organic Compounds (Nollen)	Saunders	99	0	1	0
Chemistry Principles (Slowinski)	Saunders	99	0	0	1
Chemistry (Chopin)	Silver Burdett	91	3	3	3

Table B.8

10-12 Physics Teachers' Frequency Of Use Of Different Textbooks/Programs

Textbook/Program	Publisher	Never Used	Used Occassionally	Used Frequently	The One Used Most Often
College Physics (Sears)	Addison-Wesley	86	13	1	0
Physics: Concepts and Models (Wenham)	Addison-Wesley	98	2	0	0
Elements of Physics (Boglan)	Allyn & Bacon	98	2	0	0
Physics: Its Methods & Meanings (Tuffel)	Allyn & Bacon	97	2	2	0
Physics: A Basic Science (Verwiebe)	American Book	98	2	0	0
Pathways in Science: Physics (Oxenhorn)	Globe Book	98	2	0	0
Concepts in Physics (Miller)	Harcourt, Brace, Jovanovich	94	5	1	0
PSSC Physics (Haber-Schaim)	D.C. Heath	70	11	6	13
Modern Physics (Williams)	Holt, Rinehart, & Winston	35	10	6	49*
The Project Physics (Rutherford)	Holt, Rinehart, & Winston	63	21	3	13
Conceptual Physics (Hewitt)	Little, Brown	99	0	1	0
Physics: Principles and Problems (Murphy)	Merrill	65	6	8	21*
Physics (Giamcolli)	Prentice-Hall	98	2	0	0
Physics: Foundations and Frontiers (Gamow)	Prentice-Hall	97	3	0	0
Elements of Modern Physics	Ronald Press	98	2	0	0
Physics (Genzer)	Silver Burdett	92	8	0	0
Physics: An Environmental Science	Von-Nonstrand	95	5	0	0
Physics (Halliday)	Wiley	98	2	0	0

Table B.9

Percent Of Schools Using At Least One Of The Selected Curriculum Materials By Type Of Community, School Size, And Percent Of Students In Free Lunch Program*

	Percent of Schools
Type of Community	
Rural (N=192)	31 (42)+
Small City (N=106)	53 (46)
Urban (N=37)	49 (29)
Suburban (N=143)	55 (54)
Unknown (N=8)	38 (72)
School Size	
Small (N=154)	31 (40)
Medium (N=155)	45 (45)
Large (N=153)	57 (54)
Unknown (N=24)	5 (33)
Students In Free Lunch Program	
Less Than 10% (N=119)	58 (50)
10% to 30% (N=169)	40 (57)
More Than 30% (N=52)	27 (31)
Unknown (N=146)	44 (33)

* Refer to Appendix A for definitions of reporting variables.

+ 1977 National Survey Results in ( ).

Table B.10

Percent Of Schools Using Selected Curriculum By Grade Range

Selected NSF Curriculum	Grade Range		
	K-6 (216)	7-12 (270)	K-12 Total
SCIENCE			
Elementary Science Study (ESS)	28	3	14
Individualized Science (IS)	1	1	1
Science--A Process Approach (SAPA)	4	1	2
Science Curriculum Improvement Study (SCIS)	18	3	9
Biological Science: An Ecological Approach (BSCS Green)	<1	18	10
Biological Science: An Inquiry Into Life (BSCS Yellow)	<1	4	3
Biological Science: Molecules to Man (BSCS Blue)	0	5	3
Biological Science: Interaction of Experiments & Ideas	0	1	1
Biological Science: Me and My Environment	<1	1	1
Biological Science: Patterns and Processes	0	4	2
Chemical Bond Approach (CBA)	0	2	1
Chemical Education Materials Study (CHEM STUDY)	0	13	7
Individualized Science Instructional Systems (ISIS)	<1	1	1
Introductory Physical Science (IPS)	1	26	15
Investigating the Earth--Earth Science Curriculum Project (ESCP)	<1	8	5
Outdoor Biology Instructional Strategies (OBIS)	0	2	1
Physical Science II (PSII)	0	<1	<1
Physical Science Study Committee Physics (PSSC)	0	10	5
Probing the Natural World--Intermediate Science Curriculum Study (ISCS)	0	2	1
Project Physics Course (Harvard)	0	8	5
Time, Space, and Matter--Secondary School Science Project	0	1	<1
INTERDISCIPLINARY			
MINNEMAST (Minnesota School Mathematics and Science Teaching Project)	3	0	1
Unified Science and Mathematics for Elementary Schools (USMES)	1	0	<1
Environmental Studies for Urban Youth (ESSENCE)	0	1	<1
Human Science Program (BSCS)	0	1	<1
Technology-People-Environment (Engineering Concepts Curriculum Project-ECCP)	0	1	<1
The Man Made World (Engineering Concepts Curriculum Project-ECCP)	0	1	<1

Table B.11

Elementary Teachers' Frequency Of Use Of Various Teaching Techniques In Science Classes, By Grade Range

Instructional Technique	K-3 Never	K-3 Less than Once a Month	K-3 At Least Once a Month	K-3 At Least Once a Week	K-3 Just About Daily	K-3 Missing	4-6 Never	4-6 Less than Once a Month	4-6 At Least Once a Month	4-6 At Least Once a Week	4-6 Just About Daily	4-6 Missing
Lecture/Discussion	0	6	11	47	24	12	0	3	5	41	46	5
Student reports or projects	25	30	25	12	1	8	4	35	41	13	2	6
Library work	40	29	16	5	1	9	15	46	29	5	1	6
Students work at chalkboard	40	28	12	10	1	10	36	36	12	10	1	4
Students read from text	33	5	10	30	12	10	14	7	8	34	32	5
Students answer questions/problems from text	34	8	12	28	8	10	15	6	19	37	16	7
Students use hands-on manipulative or laboratory materials	4	14	26	35	12	10	5	20	29	29	13	5
Films, video-tapes, or filmstrips	3	6	42	36	3	10	3	17	42	32	1	5
Computer-assisted instruction	74	7	4	4	1	11	60	19	10	4	0	7
Tests or quizzes	47	18	24	3	0	9	3	17	46	27	1	6
Field trips, excursions	19	63	9	0	0	10	35	55	4	2	0	5
Teacher demonstrations	3	14	43	28	4	9	6	23	35	27	4	6
Sample N	161						179					

Table B.12

Secondary Teachers' Frequency Of Use Of Various Teaching Techniques In Science Classes, By Grade Range

Instructional Technique	7-9 Never	7-9 Less than Once a Month	7-9 At Least Once a Month	7-9 At Least Once a Week	7-9 Just About Daily	7-9 Missing	10-12 Never	10-12 Less than Once a Month	10-12 At Least Once a Month	10-12 At Least Once a Week	10-12 Just About Daily	10-12 Missing
Lecture/Discussion	0	1	4	41	40	14	0	1	1	42	50	7
Student reports or projects	10	49	15	9	3	15	23	43	17	10	1	6
Library work	22	52	8	3	0	15	40	45	7	2	0	7
Students work at chalkboard	42	25	15	2	0	16	38	33	14	6	1	8
Students read from text	7	9	13	36	20	15	26	12	14	19	21	9
Students answer questions/problems from text	2	5	17	45	17	15	3	5	12	46	28	6
Students use hands-on manipulative or laboratory materials	0	7	18	43	18	14	0	2	19	65	6	8
Films, video-tapes, or filmstrips	2	7	32	42	2	15	4	22	38	30	1	6
Computer-assisted instruction	57	24	2	2	0	15	55	32	5	1	0	8
Tests or quizzes	0	3	31	50	2	14	0	1	37	53	1	8
Field trips, excursions	53	31	3	0	0	13	60	33	2	0	0	5
Teacher demonstrations	2	14	33	35	3	13	1	15	35	39	3	7
Sample N				242						222		

Table B.13

Teachers Use Of Selected Teaching Techniques
At Least Once A Week Or More Often, By Science Subject

Teaching Techniques	K-6	7-9 Life Science	7-9 Earth Science	7-9 Physical Science	10-12 Biology	10-12 Chemistry	10-12 Physics
Lecture/Discussion	79	83	86	81	96	89	90
Students read from texts	55	62	65	48	44	40	34
Students answer questions/ problems from text	45	62	68	61	56	86	82
Students use hands-on or manipulative lab materials	44	61	59	68	77	81	54
Films, videotapes, or filmstrips	36	58	57	24	55	14	18
Tests or quizzes	16	52	66	44	63	56	41
Teacher demonstrations	31	35	42	42	32	44	53
Sample N	340	71	79	84	82	72	68

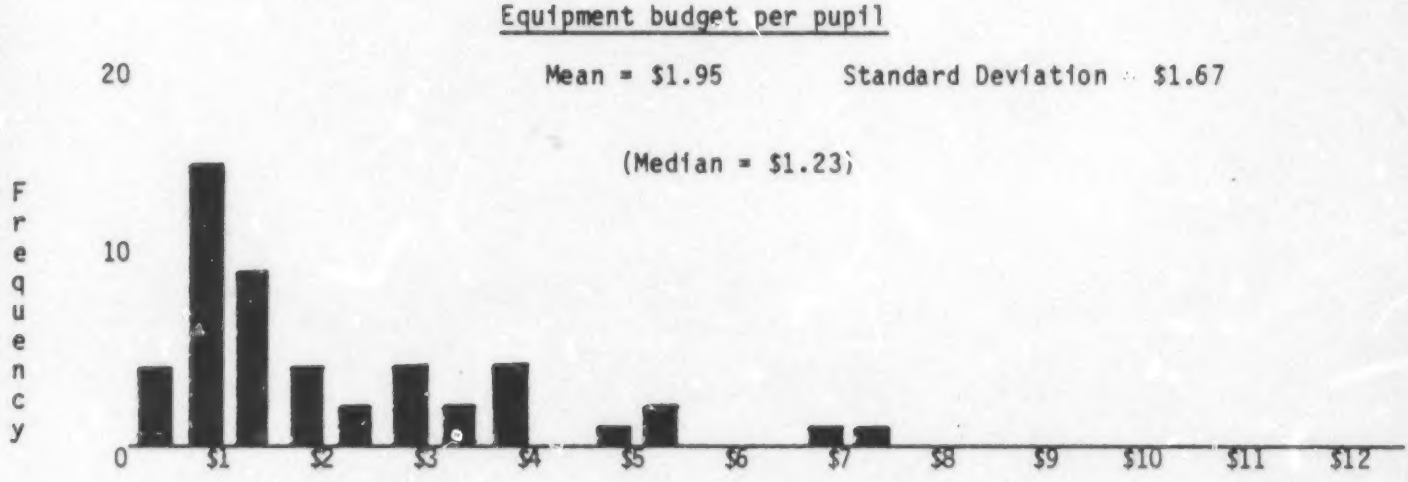
Table B.14

Teachers Use Of Selected Teaching Techniques
At Least Once A Week Or More Often, By District Strata

Teaching Techniques	Cities of the first class	7-county metro suburbs	More Than 2000 students	1000-1999 students	0-999 students
Lecture/Discussion	84	80	84	83	91
Students read from texts	51	49	50	55	56
Students answer questions/problems from texts	59	52	55	65	71
Students use hands-on or manipulative lab materials	54	66	53	51	43
Films, videotapes, or filmstrips	27	40	40	33	33
Tests or quizzes	32	32	44	40	44
Teacher demonstrations	39	39	36	27	34
Sample N	92	321	165	94	129

Table B.15

Frequency Distribution Of Science Equipment
And Supply Budgets Per Pupil For K-6 Schools



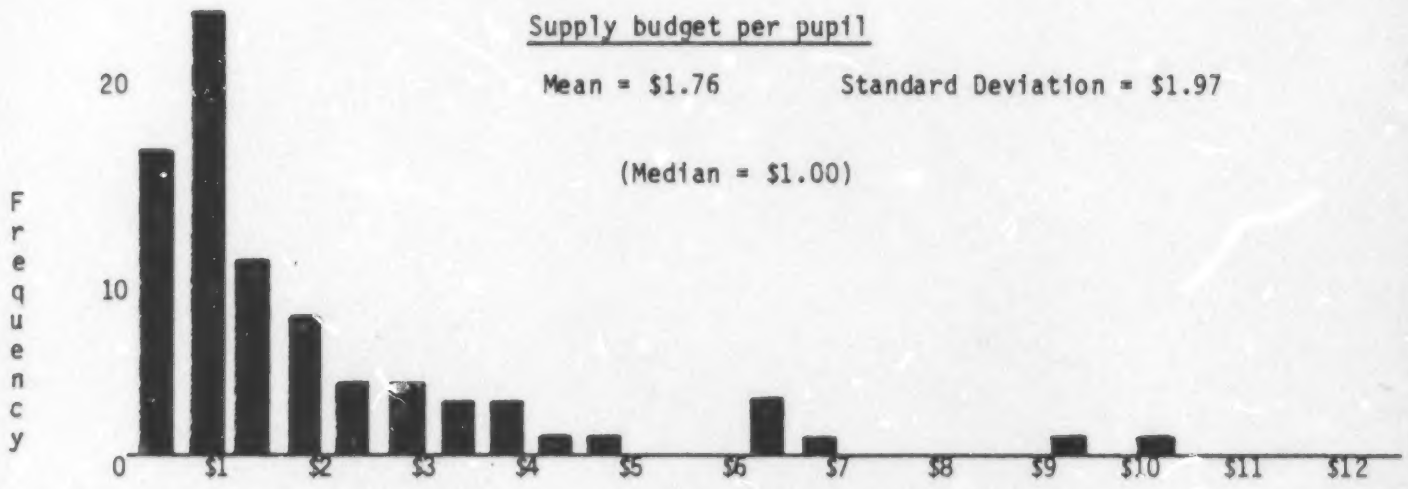


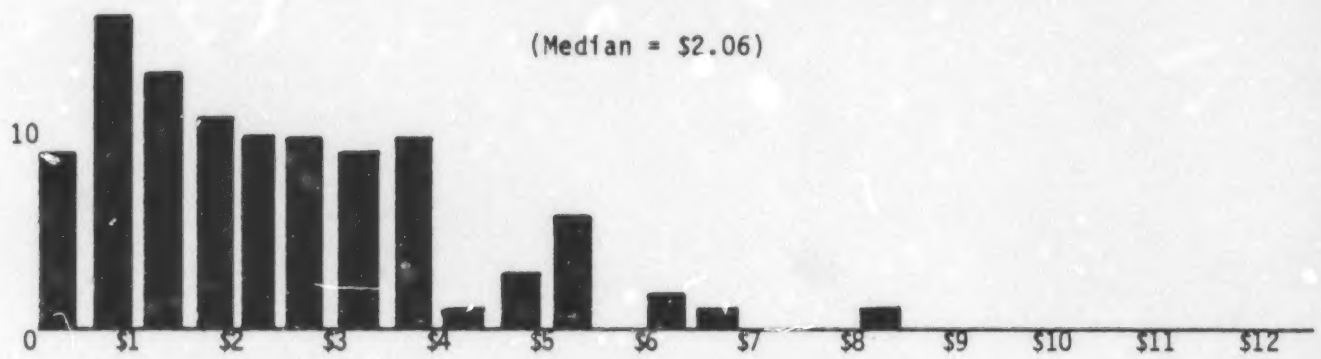
Table B.16

Frequency Distribution Of Science Equipment
And Supply Budgets Per Pupil For 7-9 Schools

Equipment budget per pupil

Mean = $2.40 Standard Deviation = $1.66

(Median = $2.06)



Supply budget per pupil

Mean = $3.46 Standard Deviation = $2.25

(Median = $2.94)

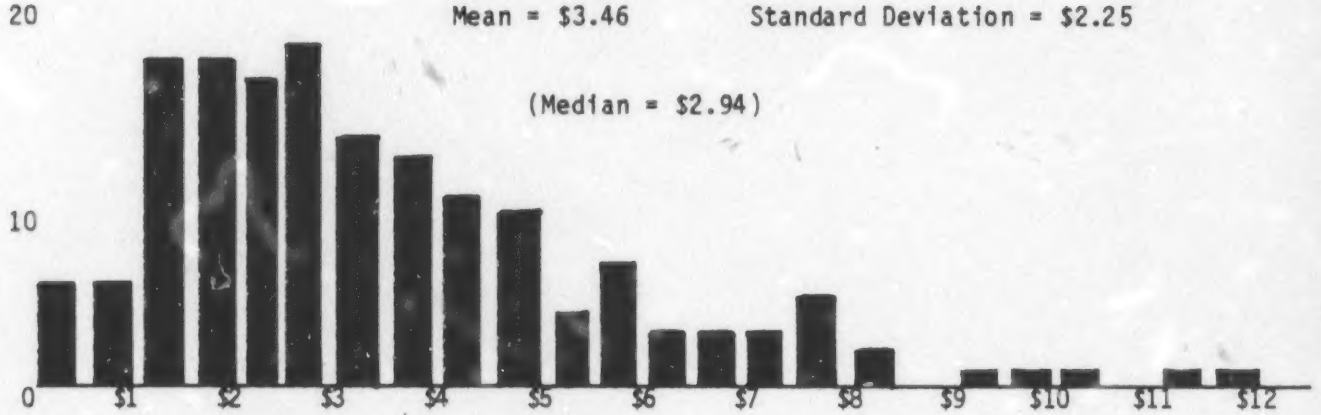


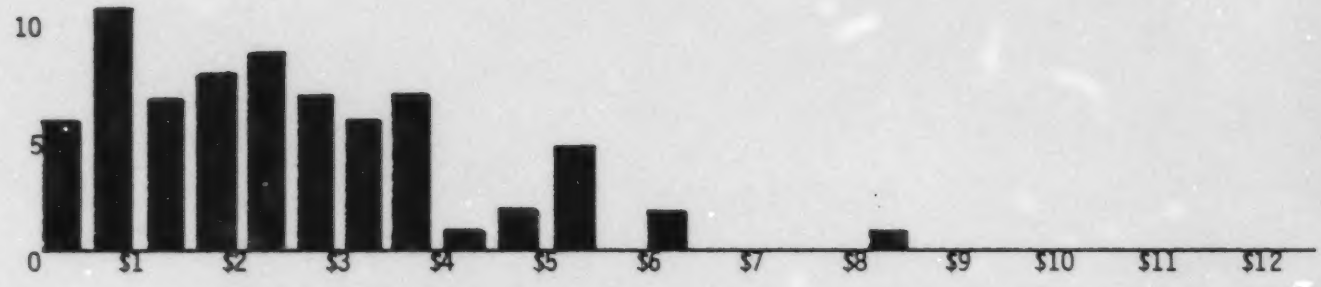
Table B.17

Frequency Distribution Of Science Equipment
And Supply Budgets Per Pupil For 10-12 Schools

Equipment budget per pupil

Mean = $2.49 Standard Deviation = $1.68

(Median = $2.15)



Supply budget per pupil

Mean = $3.84 Standard Deviation = $2.33

(Median = $3.27)

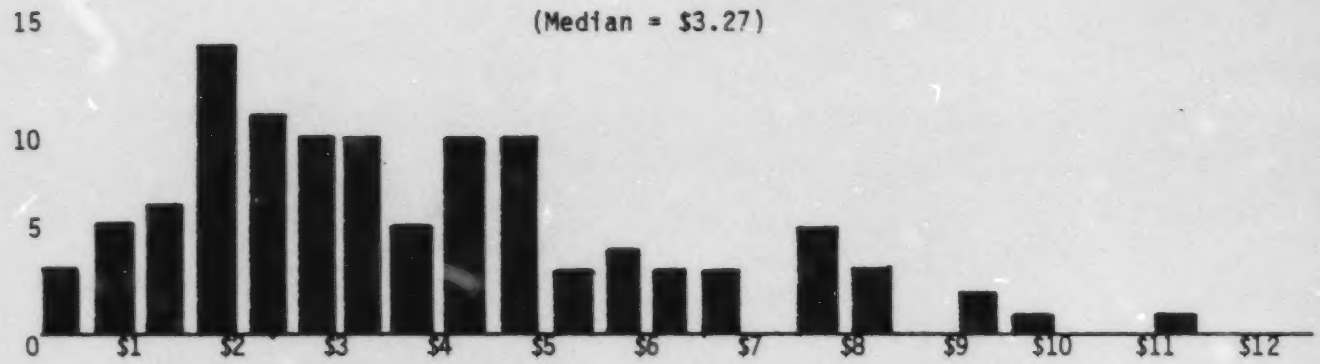


Table B.18

Elementary Teachers' Rating Of Facilities, Equipment, And Supplies, By Grade Range

Facilities, Equipment, & Supplies	K-3					4-6				
	Not Relevant	Very Good	Satisfactory	Improvement Needed	Missing	Not Relevant	Very Good	Satisfactory	Improvement Needed	Missing
Facilities - building and classroom fixtures	10	10	45	27	8	4	10	39	43	5
Equipment - nonconsumable, nonperishable items such as microscopes, scales, etc.	6	11	30	44	8	1	10	25	61	3
Supplies-materials that must continually be replenished such as chemicals, dry cells, glassware, etc.	15	12	30	34	9	3	12	31	50	4
Money to buy supplies on a day-to-day basis	11	4	17	58	9	5	6	27	58	4
Storage space for equipment and supplies	4	12	35	40	9	3	6	30	57	4
Space available for classroom preparation	4	10	37	40	9	2	7	33	55	4
Spaces for small groups to work	4	10	39	39	8	1	5	25	65	5
Availability of laboratory assistants or paraprofessional help	27	1	7	56	9	20	0	8	68	4
Sample N			161					179		

Table B.19

Secondary Teachers' Rating Of Facilities, Equipment, And Supplies, By Grade Range

Facilities, Equipment, & Supplies	7-9					10-12				
	Not Relevant	Very Good	Satisfactory	Improvement Needed	Missing	Not Relevant	Very Good	Satisfactory	Improvement Needed	Missing
Facilities - building and classroom fixtures	0	32	28	26	14	0	41	33	21	5
Equipment - nonconsumable, nonperishable items such as microscopes, scales, etc.	1	32	30	24	14	1	32	41	22	5
Supplies-materials that must continually be replenished such as chemicals, dry cells, glassware, etc.	0	31	37	18	14	0	37	37	20	5
Money to buy supplies on a day-to-day basis	1	18	29	37	14	1	17	33	44	5
Storage space for equipment and supplies	0	26	31	29	14	1	31	34	30	5
Space available for classroom preparation	0	26	36	24	13	0	30	44	21	5
Spaces for small groups to work	1	10	29	46	13	2	14	35	44	6
Availability of laboratory assistants or paraprofessional help	13	4	12	57	14	14	5	18	59	5
Sample N			242					222		

Table B.20

Percent Of Teachers Indicating That Improvement
Is Needed in Facilities, Equipment, Or Supplies, by Science Subject

Facilities, Equipment, & Supplies	K-6	7-9 Life Science	7-9 Earth Science	7-9 Physical Science	10-12 Biology	10-12 Chemistry	10-12 Physics
Facilities - building and classroom fixtures	36	31	33	19	22	17	24
Equipment - nonconsumable, nonperishable items such as microscopes, scales, etc.	53	30	22	24	13	21	32
Supplies - materials that must continually be replenished such as chemicals, dry cells, glassware, etc.	42	11	24	19	17	22	22
Money to buy supplies on a day to day basis	58	38	42	36	37	47	49
Storage space for equipment and supplies	49	35	33	23	32	33	25
Space available for classroom preparation	48	25	29	20	21	21	21
Spaces for small groups to work	52	56	49	39	55	40	34
Availability of laboratory assistants or paraprofessional help	62	63	59	56	55	69	51
Sample N	340	71	79	84	82	72	68

Table B.21

Percent Of Teachers Indicating That Improvement Is Needed In Facilities, Equipment, Or Supplies, By District Strata

Facilities, Equipment, and Supplies	Cities of the first class	7-county metro suburbs	More Than 2000 students	1000-1999 students	0-999 students
Facilities - building and classroom fixtures	30	28	26	33	30
Equipment - nonconsumable, nonperishable items such as microscopes, scales, etc.	57	27	26	39	51
Supplies - materials that must continually be replenished such as chemicals, dry cells, glassware, etc.	50	22	20	32	40
Money to buy supplies on a day-to-day basis	73	42	42	47	53
Storage space for equipment and supplies	41	35	33	44	44
Space available for classroom preparation	43	31	31	36	31
Spaces for small groups to work	55	45	47	59	43
Availability of laboratory assistants or paraprofessional help	76	54	57	65	64
Sample N	92	321	165	94	129

Table B.22

Average Age Of Teachers By District Strata And Grade Range

Strata	Average Age of Teachers K-3	4-6	7-9	10-12	K-12 Total
Cities of the first class	42 (2.09)+	47 (1.76)	42 (1.97)	46 (1.49)	44 (0.89)
7-county metro suburbs	41 (1.27)	40 (1.00)	41 (0.91)	43 (1.06)	41 (0.52)
More than 2000 students	44 (2.11)	40 (1.52)	43 (1.29)	44 (1.20)	43 (0.72)
1000-1999 students	40 (2.89)	42 (2.47)	40 (2.06)	39 (1.36)	40 (1.03)
0-999 students	40 (2.24)	38 (1.59)	40 (1.87)	38 (1.34)	39 (0.83)
Sample N	151	172	239	219	781

+ Standard error in ( ).

Table B.23

Average Number Of Years Teaching Experience
By District Strata And Grade Range

Strata	Average Years Teaching Experience K-3	4-6	7-9	10-12	K-12 Total
Cities of the first class	16.5 (1.94)+	19.4 (1.20)	15.7 (2.17)	21.1 (1.84)	18.3 (0.82)
7-county metro suburbs	15.8 (1.08)	15.0 (0.72)	16.9 (0.81)	19.1 (0.92)	16.8 (0.45)
More than 2000 students	18.4 (1.56)	15.9 (1.29)	18.1 (1.12)	19.7 (1.17)	18.2 (0.63)
1000-1999 students	14.6 (2.23)	15.6 (1.30)	15.4 (1.71)	16.0 (1.27)	15.4 (0.79)
0-999 students	15.3 (1.90)	14.0 (1.25)	15.9 (1.62)	13.4 (1.23)	14.5 (0.72)
Sample N	158	174	238	222	792

+ Standard error in ( ).

Table B.24
Elementary Teachers' Needs For Assistance, By Grade Range

Area of Assistance	K-3 Do Not Need Assistance	K-3 Do Not Receive Adequate Assistance	K-3 Receive Adequate Assistance	K-3 Missing	4-6 Do Not Need Assistance	4-6 Do Not Receive Adequate Assistance	4-6 Receive Adequate Assistance	4-6 Missing
Establishing Instructional objectives	61	27	8	4	54	37	8	1
Lesson planning	73	21	4	3	72	22	5	1
Learning new methods	26	57	17	4	31	54	10	5
Actually teaching lessons	60	31	6	3	58	35	7	1
Obtaining information about instructional materials	26	50	19	4	32	53	13	3
Obtaining subject matter information	41	37	18	4	34	51	12	2
Implementing discovery/inquiry approach	47	35	14	4	45	42	11	2
Using manipulative or hands-on materials	46	37	14	3	45	44	11	1
Maintaining equipment	37	42	17	4	45	40	13	2
Working with small groups of students	48	40	8	4	56	39	3	2
Maintaining discipline	85	8	4	4	86	11	2	1
Articulating instruction across grade levels	55	28	12	5	45	43	8	5
Maintaining live animals and plants	48	34	14	4	49	39	10	3
Obtaining information about how to use computers in science teaching	11	67	18	4	16	65	16	3
Training in computer programming	16	58	22	4	17	55	25	3
Obtaining information about available science computer software	8	70	18	4	10	68	20	3
Readily available day-to-day help in classroom use of computers	12	68	14	6	17	67	13	4
Sample N			161				179	

Table B.25
Secondary Teachers' Needs For Assistance, By Grade Range

Area of Assistance	7-9 Do Not Need Assistance	7-9 Do Not Receive Adequate Assistance	7-9 Do Not Receive Adequate Assistance	7-9 Missing	10-12 Do Not Need Assistance	10-12 Do Not Receive Adequate Assistance	10-12 Do Not Receive Adequate Assistance	10-12 Missing
Establishing Instructional objectives	71	18	10	2	75	16	6	3
Lesson planning	86	6	7	2	90	4	3	2
Learning new methods	34	50	13	3	33	56	8	3
Actually teaching lessons	81	11	5	4	82	14	2	3
Obtaining information about instructional materials	31	53	14	2	32	56	10	2
Obtaining subject matter information	44	39	15	2	59	28	11	3
Implementing discovery/inquiry approach	50	38	10	2	60	32	6	3
Using manipulative or hands-on materials	55	31	11	3	69	24	5	2
Maintaining equipment	53	30	13	3	56	32	9	3
Working with small groups of students	61	30	4	5	65	28	4	3
Maintaining discipline	78	13	7	2	88	5	4	3
Articulating instruction across grade levels	49	39	7	5	52	35	8	5
Maintaining live animals and plants	64	22	7	8	65	20	7	8
Obtaining information about how to use computers in science teaching	12	65	20	3	19	60	17	4
Training in computer programming	12	61	23	4	25	54	19	3
Obtaining information about available science computer software	11	65	22	3	16	61	19	4
Readily available day-to-day help in classroom use of computers	14	65	17	4	24	60	11	5
Sample N		242				222		

Table B.26
Percent Of Teachers Indicating A Need For
Additional Assistance In Various Areas, By Science Subject

Area of Assistance	K-6	7-9 Life Science	7-9 Earth Science	7-9 Physical Science	10-12 Biology	10-12 Chemistry	10-12 Physics
Establishing instructional objectives	32	16	20	17	15	18	16
Lessor planning	21	7	8	4	2	3	7
Learning new methods	56	48	46	54	52	54	62
Actually teaching lessons	33	15	14	5	10	18	13
Obtaining information about instructional materials	51	58	49	52	51	60	57
Obtaining subject matter information	45	42	35	42	29	33	19
Implementing discovery/ inquiry approach	39	52	39	27	37	28	29
Using manipulative or hands-on materials	41	47	29	23	28	18	26
Maintaining equipment	41	32	35	25	34	33	29
Working with small groups of students	40	39	34	19	35	19	26
Maintaining discipline	9	13	10	15	5	7	3
Articulating instruction across grade levels	36	45	38	35	30	39	35
Maintaining live animals and plants	36	25	29	11	30	17	12
Obtaining information about how to use computers in science teaching	66	69	65	64	57	64	59
Training in computer programming	56	66	67	52	56	57	47
Obtaining information about available science computer software	69	70	62	62	61	64	59
Readily available day-to-day help in classroom use of computers	67	70	65	62	66	53	60
Sample N	340	71	79	84	82	72	68

Table B.27

Percent Of Teachers Indicating A Need For
Additional Assistance In Various Areas, By District Strata

Area of Assistance	Cities of the first class	7-county metro suburbs	More Than 2000 students	1000-1999 students	0-999 students
Establishing instructional objectives	27	19	24	33	25
Lesson planning	15	12	10	15	12
Learning new methods	38	55	49	61	62
Actually teaching lessons	24	20	18	23	23
Obtaining information about instructional materials	50	54	54	57	50
Obtaining subject matter information	46	40	33	38	37
Implementing discovery/inquiry approach	33	34	34	41	46
Using manipulative or hands-on materials	38	26	34	33	47
Maintaining equipment	36	35	32	31	43
Working with small groups of students	38	31	35	38	37
Maintaining discipline	20	9	10	6	5
Articulating instruction across grade levels	37	38	38	39	30
Maintaining live animals and plants	24	26	26	28	34
Obtaining information about how to use computers in science teaching	64	63	62	68	67
Training in computer programming	53	55	53	67	64
Obtaining information about available science computer software	67	65	63	66	69
Readily available day-to-day help in classroom use of computers	73	63	59	68	67
Sample	92	321	165	94	129

Table B.28

Principals' Rating Of The Utility Of Each Of A Number Of Sources Of Information, By Grade Range

Source of Information	K-6 Not Useful	K-6 Somewhat Useful	K-6 Very Useful	K-6 Unknown	7-9 Not Useful	7-9 Somewhat Useful	7-9 Very Useful	7-9 Unknown
Teachers	7	60	33	0	3	56	40	1
Principals	2	46	51	1	1	43	53	2
Local Science Specialists/ Coordinators	10	38	48	4	15	40	34	11
State Department Personnel	26	55	18	1	22	60	16	2
College Courses	14	63	21	2	22	64	13	1
Local Inservice Programs	4	43	52	1	6	56	37	1
Federally Sponsored Workshops	14	58	24	4	24	58	15	3
Teacher Union Meetings	80	11	0	9	82	11	1	6
Meetings of Professional Organizations	8	52	40	0	5	42	51	2
Journals and Other Professional Publications	4	41	55	0	0	42	57	1
Publishers and Sales Representatives	16	69	14	1	32	59	6	3
Parents	46	50	3	1	54	44	1	1
Sample N		216				270		

Table B.29

Elementary Teachers' Rating Of The Utility Of Each Of A Number Of Sources Of Information About What Topics To Teach In Science, By Grade Range

Source of Information	K-3 Not Useful	K-3 Somewhat Useful	K-3 Very Useful	K-3 Unknown	4-6 Not Useful	4-6 Somewhat Useful	4-6 Very Useful	4-6 Unknown
Teachers	13	47	39	1	15	58	27	1
Principals	66	31	2	1	71	25	2	2
Local Science Specialists/ Coordinators	34	40	24	2	46	36	15	3
State Department Personnel	65	31	4	1	68	25	5	2
College Courses	17	58	23	2	18	63	18	2
Local Inservice Programs	22	44	33	1	25	50	22	3
Federally Sponsored Workshops	43	37	17	4	46	33	17	5
Teacher Union Meetings	88	11	0	1	86	11	0	3
Meetings of Professional Organizations	63	32	4	1	86	11	0	3
Journals and Other Professional Publications	29	52	17	1	63	29	6	3
Publishers and Sales Representatives	58	34	7	1	23	59	16	2
Parents	55	40	4	1	70	27	2	1
Sample N		161						

Table B.30

Secondary Teachers' Rating Of The Utility Of Each Of A Number Of Sources Of Information About What Topics To Teach In Science, By Grade Range

Source of Information	7-9 Not Useful	7-9 Somewhat Useful	7-9 Very Useful	7-9 Unknown	10-12 Not Useful	10-12 Somewhat Useful	10-12 Very Useful	10-12 Unknown
Teachers	7	45	48	1	13	51	37	0
Principals	81	17	2	0	84	14	1	0
Local Science Specialists/ Coordinators	58	28	9	5	57	34	5	4
State Department Personnel	55	38	5	3	53	44	2	1
College Courses	5	56	38	1	4	54	41	1
Local Inservice Programs	36	48	15	1	41	45	11	2
Federally Sponsored Workshops	26	36	32	5	23	35	38	4
Teacher Union Meetings	83	16	0	1	81	17	1	1
Meetings of Professional Organizations	26	50	24	0	23	51	26	1
Journals and Other Professional Publications	7	60	33	0	8	46	47	0
Publishers and Sales Representatives	44	49	6	1	51	44	5	0
Parents	72	26	1	1	66	31	3	0
Sample N		242				222		

Table B.31

Elementary Teachers' Rating Of The Utility Of Each Of A Number Of Sources Of Information About How To Teach In Science, By Grade Range

Source of Information	K-3 Not Useful	K-3 Somewhat Useful	K-3 Very Useful	K-3 Unknown	4-6 Not Useful	4-6 Somewhat Useful	4-6 Very Useful	4-6 Unknown
Teachers	10	45	45	1	17	49	34	0
Principals	68	28	3	2	72	25	3	1
Local Science Specialists/ Coordinators	35	44	20	2	41	39	18	3
State Department Personnel	70	26	3	1	72	24	3	2
College Courses	14	54	30	2	19	54	27	0
Local Inservice Programs	20	45	34	1	27	43	29	1
Federally Sponsored Workshops	47	32	18	3	50	30	17	3
Teacher Union Meetings	88	9	0	3	88	9	1	2
Meetings of Professional Organizations	71	25	3	2	64	30	5	2
Journals and Other Professional Publications	31	51	17	1	32	50	17	1
Publishers and Sales Representatives	56	35	7	2	54	40	5	1
Parents	75	22	3	1	80	17	1	2
Sample N		161						

Table B.32

Secondary Teachers' Rating Of The Utility Of Each Of A Number Of Sources Of Information About How To Teach In Science, By Grade Range

Source of Information	7-9 Not Useful	7-9 Somewhat Useful	7-9 Very Useful	7-9 Unknown	10-12 Not Useful	10-12 Somewhat Useful	10-12 Very Useful	10-12 Unknown
Teachers	7	42	52	0	6	46	46	1
Principals	74	23	3	0	78	20	1	0
Local Science Specialists/ Coordinators	62	28	7	4	62	29	5	3
State Department Personnel	64	31	4	1	67	31	1	1
College Courses	20	56	23	1	19	56	25	0
Local Inservice Programs	29	54	16	1	37	50	13	1
Federally Sponsored Workshops	31	36	28	5	27	37	32	5
Teacher Union Meetings	82	17	1	0	85	12	2	1
Meetings of Professional Organizations	33	48	19	0	31	45	22	2
Journals and Other Professional Publications	17	57	25	0	16	54	30	0
Publishers and Sales Representatives	57	39	3	1	64	34	2	1
Parents	81	18	0	1	79	19	1	1
Sample N		242						

Table B.33
Principals' Rating Of The Seriousness Of Each Of A Number
Of Factors Affecting Science Instruction, By Grade Range

Factor	K-6 Serious Problem	K-6 Somewhat of a Problem	K-6 Not A Significant Problem	K-6 Missing	7-12 Serious Problem	7-12 Somewhat of a Problem	7-12 Not A Significant Problem	7-12 Missing
Belief that science is less important than other subjects	7	47	46	0	2	7	92	0
...of Student Counselors	2	14	74	10	2	97	1	0
Compliance with federal regulations	2	16	81	1	1	9	88	2
Inadequate facilities	10	42	48	0	2	25	72	1
Insufficient funds for purchasing equipment and supplies	13	39	47	1	6	39	54	0
Lack of materials for individualizing instruction	13	46	41	0	8	40	52	0
Out-of-date teaching materials	7	31	62	0	2	27	71	1
Insufficient numbers of textbooks	4	12	83	1	2	13	85	1
Lack of student interest in science	2	31	67	1	6	44	50	1
Inadequate student reading abilities	1	34	65	0	4	56	40	0
Inadequate student mathematical abilities	1	26	71	1	2	49	49	0
Lack of teacher interest in science	13	54	33	1	1	14	84	0
Teachers inadequately prepared to teach science	19	55	26	1	1	13	85	2
Lack of teacher planning time	14	41	45	0	3	21	76	1
Not enough time to teach science	15	43	42	1	3	21	76	1
Class sizes too large	7	34	59	1	6	32	61	1
Difficulty in maintaining discipline	1	12	88	0	2	14	84	0
Inadequate articulation of instruction across grade levels	5	42	53	0	4	42	53	0
Inadequate diversity of science electives	5	17	72	7	3	29	69	0
Low enrollments in science courses	4	4	86	6	6	24	69	1
Lack of readily available advice or help for teachers in science instruction	12	48	39	1	4	30	65	1
Sample N		216				270		

Table B.38

Percent Of Teachers Reporting Various Numbers Of Computers Available For Teacher Use, By District Strata

District Strata	Number of Computers						Missing
	None	One	Two	Three to Six	Seven to Ten	More Than Ten	
Cities of the First Class (N=92)	12	37	17	16	8	2	8
Seven County Metro Suburbs (N=321)	8	20	12	25	10	14	12
More Than 2000 Students (N=165)	10	27	14	24	8	4	13
1000-1999 Students (N=94)	13	26	10	20	15	2	15
0-999 Students (N=129)	9	22	19	33	5	7	5

Table B.39
Principals' Rating Of The Seriousness Of Each Of A Number Of
Factors Affecting The Use Of Computers In Science Instruction, By Grade Range

Factor	K-6 Serious Problem	K-6 Somewhat of a Problem	K-6 Not A Significant Problem	K-6 Missing	7-12 Serious Problem	7-12 Somewhat of a Problem	7-12 Not A Significant Problem	7-12 Missing
Belief of administration that computers are not a useful tool	1	4	91	4	0	0	97	3
Belief of teachers that computers are not a useful tool	2	39	56	4	2	32	63	3
Insufficient numbers of terminals or microcomputers	22	54	20	4	14	54	28	3
Lack of technical support for maintenance and repair of terminals or microcomputers	7	38	50	4	7	28	62	3
Inconvenient location of terminals or microcomputers	8	43	44	4	5	53	40	3
Lack of student interest in computers	0	1	95	4	0	2	94	3
Inadequate student cognitive abilities	1	18	76	5	1	22	73	4
Lack of teacher comfort in using computers	22	60	13	4	14	64	17	4
Lack of teacher training how to incorporate computers into science teaching	35	54	7	4	19	61	17	3
Lack of teacher interest in using computers	9	50	38	4	6	42	50	3
Lack of continuing assistance in the use of computers in science teaching	22	57	17	4	13	57	27	3
Lack of teacher training in computer programming	37	50	9	5	22	57	19	3
Inadequate number of science software programs	34	54	7	5	19	59	18	3
Inappropriate software topics for our science curriculum	30	51	13	6	16	59	21	4
Low quality of available science software	27	51	17	6	13	59	23	6
Not enough time to use computers in science teaching	24	49	22	6	13	53	30	4
			216				270	

Table B.40
Elementary Teachers' Rating Of The Seriousness Of Each Of A Number Of Factors Affecting The Use Of Computers In Science Instruction, By Grade Range

Factor	K-3 Serious Problem	K-3 Somewhat of a Problem	K-3 Not A Significant Problem	K-3 Missing	4-6 Serious Problem	4-6 Somewhat of a Problem	4-6 Not A Significant Problem	4-6 Missing
Belief of administration that computers are not a useful tool	1	6	90	3	2	8	89	2
Belief of teachers that computers are not a useful tool	1	28	68	3	3	36	59	2
Insufficient numbers of terminals or microcomputers	49	37	11	3	50	36	12	2
Lack of technical support for maintenance and repair of terminals or microcomputers	29	32	34	6	23	43	32	3
Inconvenient location of terminals or microcomputers	37	38	22	4	36	35	26	3
Lack of student interest in computers	1	3	93	3	2	3	94	2
Inadequate student cognitive abilities	1	35	60	4	5	41	51	3
Lack of teacher comfort in using computers	24	57	17	3	26	58	14	2
Lack of teacher training in how to incorporate computers into science teaching	44	41	12	3	50	38	10	2
Lack of teacher interest in using computers	9	40	47	4	8	44	46	2
Lack of continuing assistance in the use of computers in science teaching	32	44	19	4	31	54	12	3
Lack of teacher training in computer programming	41	39	17	4	51	39	8	2
Inadequate number of science software programs	50	35	8	7	53	37	6	4
Inappropriate software topics for our science curriculum	46	35	11	8	55	34	7	5
Low quality of available science software	35	34	18	14	38	41	10	1
Not enough time to use computers in science teaching	48	35	10	6	49	38	10	3
			161				179	

Table B.41
Secondary Teachers' Rating Of The Seriousness Of Each Of A Number Of Factors Affecting The Use Of Computers In Science Instruction, By Grade Range

Factor	7-9 Serious Problem	7-9 Somewhat of a Problem	7-9 Not A Significant Problem	7-9 Missing	10-12 Serious Problem	10-12 Somewhat of a Problem	10-12 Not A Significant Problem	10-12 Missing
Belief of administration that computers are not a useful tool	3	10	87	0	3	10	87	1
Belief of teachers that computers are not a useful tool	6	36	58	1	6	38	55	1
Insufficient numbers of terminals or microcomputers	50	40	8	2	48	39	11	1
Lack of technical support for maintenance and repair of terminals or microcomputers	22	37	36	5	19	39	37	5
Inconvenient location of terminals or microcomputers	40	41	18	2	42	40	17	1
Lack of student interest in computers	3	8	87	2	3	14	82	1
Inadequate student cognitive abilities	14	44	40	3	12	53	33	2
Lack of teacher comfort in using computers	34	53	12	1	30	50	18	2
Lack of teacher training in how to incorporate computers into science teaching	57	36	6	1	50	37	12	1
Lack of teacher interest in using computers	14	47	38	1	15	47	37	1
Lack of continuing assistance in the use of computers in science teaching	35	50	12	3	32	50	16	2
Lack of teacher training in computer programming	58	32	8	2	43	47	12	1
Inadequate number of science software programs	55	35	7	3	39	45	13	3
Inappropriate software topics for our science curriculum	48	40	9	3	37	46	15	3
Low quality of available science software	37	43	15	6	33	42	19	5
Not enough time to use computers in science teaching	48	37	12	3	47	40	10	3
			242				222	

Table B.42

Percent of Teachers Indicating That Each Factor Is A Serious Problem For The Use Of Computers In Science Instruction, By Grade Range

Factor	K-6	7-9 Life Science	7-9 Earth Science	7-9 Physical Science	10-12 Biology Science	10-12 Chemistry Science	10-12 Physics Science
Belief of administration that computers are not a useful tool	2	3	3	2	2	3	3
Belief of teachers that computers are not a useful tool	2	9	4	6	7	4	6
Insufficient numbers of terminals or microcomputers	50	47	49	55	42	51	53
Lack of technical support for maintenance and repair of terminals or microcomputers	26	20	23	23	17	14	27
Inconvenient location of terminals or microcomputers	37	37	39	43	35	51	40
Lack of student interest in computers	1	4	1	4	4	1	3
Inadequate student cognitive abilities	3	17	10	17	12	11	12
Lack of teacher comfort in using computers	25	38	32	35	32	28	31
Lack of teacher training in how to incorporate computers into science teaching	47	68	53	55	49	51	50
Lack of teacher interest in using computers	9	17	13	14	22	10	13
Lack of continuing assistance in the use of computers in science teaching	32	39	29	36	38	26	31
Lack of teacher training in computer programming	46	66	49	60	44	39	46
Inadequate number of science software programs	51	56	47	60	37	42	38
Inappropriate software topics for our science curriculum	51	49	41	56	38	38	34
Low quality of available science software	37	34	39	38	34	35	29
Not enough time to use computers in science teaching	49	44	51	46	46	44	52
Sample N	340	71	79	84	82	72	68

Table B.43
Percent Of Teachers Indicating That Each Factor
Is A Serious Problem, By District Strata

Factor	Cities Than first class	1000-metro suburbs	More of the 2000 students	1999 students	7-county 0-999 students
Belief of administration that computers are not a useful tool	4	2	1	3	2
Belief of teachers that computers are not a useful tool	4	5	4	4	5
Insufficient numbers of terminals or microcomputers	67	46	47	48	49
Lack of technical support for maintenance and repair of terminals or microcomputers	26	23	24	20	18
Inconvenient location of terminals or microcomputers	45	35	39	44	40
Lack of student interest in computers	3	1	3	2	2
Inadequate student cognitive abilities	14	7	10	12	6
Lack of teacher comfort in using computers	34	24	33	32	31
Lack of teacher training in how to incorporate computers into science teaching	60	46	54	61	47
Lack of teacher interest in using computers	19	10	15	11	9
Lack of continuing assistance in the use of computers in science teaching	47	28	37	33	27
Lack of teacher training in computer programming	58	42	56	52	47
Inadequate number of science software programs	59	52	46	48	39
Inappropriate software topics for our science curriculum	57	46	46	50	35
Low quality of available science software	47	41	29	33	26
Not enough time to use computers in science teaching	55	44	44	57	48
Sample N	92	321	165	94	129

APPENDIX C

Estimation of Standard Errors

APPENDIX C

Estimation of Standard Errors

The sampling error for this survey for a given proportion p, sample size n, and reporting group can be determined by using the generalized table or calculated by:

$$SE(p) = \frac{p\,(1-p)}{n-1}$$

The value p (1-p)/(n-1) is the estimated variance of p based on a simple random sample. That is, the entries on the generalized sampling error table have not been corrected for the effects of the stratified cluster design used in this survey. Thus, the sampling errors on the table may be underestimates of the error.

The following examples will illustrate the use of this table. In Chapter 6 it was estimated that 6 percent of the K-6 teachers are male.

Table C.1 (teacher and principal standard errors) would be entered with the p-value (in this case 5 percent) determining the column and the sample size determining the row. Since there is no row for n=161, the n=150 row would be used[1]. The intersection of the 5 percent column and the 150 row indicate that the standard error is 1.79. The 95 percent confidence interval for the percent of teachers is the estimated 6 percent $\pm$3.58, or roughly from 2 percent to 10 percent. Similarly, the standard error for grade 4-6 male teachers (p=46, n=179) is approximately 7.58 (the tabled value for p=50 and n=175), and the 95 percent confidence interval is roughly 38 percent to 54 percent. Since these two confidence intervals do not overlap, it is clear that there are significantly more male 4-6 teachers than male K-3 teachers.

It is also possible for differences for be statistically significant if the two confidence intervals do overlap. If the observed difference is at least twice the standard error of the difference, then the difference is significant at the 0.05 level. The estimated standard error of the difference can be calculated as:

$$SE(p_1-p_2) = SEp_1 + SEp_2$$

Thus, if an estimate of 83 percent has a standard error of 2.4 and an estimate of 90 percent has a standard error of 2.0, the standard error of the difference is $(2.4)^2 + (2.0)^2 = 3.2$. Since the observed difference, 7, is more than twice the standard error, 3, this difference is statistically significant, even though the confidence intervals overlap (78-88 percent and 86 to 94 percent).

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[1] Using the smaller n and the p-value closest to 50 percent when the exact values are not in the table would be the more conservative approach. However, for most purposes it is sufficient to use the closest value. In either case one can interpolate the standard error value if a more precise estimate is desired.

Table C.1

Table Of Generalized Standard Errors For Teacher And Principal Samples[1]

Sampling Size (n)	Sampling, Errors in Percents p-Values in Percents						
	2 or 98	5 or 95	10 or 90	20 or 80	30 or 70	40 or 60	50
25	2.86	4.45	6.12	8.16	9.35	10.00	10.20
50	2.00	3.11	4.29	5.71	6.55	7.00	7.14
60	1.82	2.84	3.91	5.21	5.97	6.38	6.51
70	1.69	2.76	3.61	4.82	5.52	5.90	6.02
75	1.63	2.53	3.48	4.65	5.33	5.69	5.81
80	1.58	2.45	3.38	4.50	5.16	5.51	5.63
85	1.53	2.38	3.27	4.36	5.00	5.35	5.46
90	1.48	2.31	3.18	4.24	4.86	5.19	5.30
95	1.44	2.25	3.09	4.13	4.73	5.05	5.16
100	1.41	2.19	3.02	4.02	4.61	4.92	5.03
125	1.26	1.96	2.69	3.59	4.12	4.40	4.49
150	1.15	1.79	2.46	3.28	3.75	4.01	4.10
175	1.06	1.65	2.27	3.03	3.47	3.71	3.79
200	0.99	1.54	2.13	2.84	3.25	3.47	3.54
225	0.94	1.46	2.00	2.67	3.06	3.27	3.34
250	0.89	1.38	1.90	2.53	2.90	3.10	3.17
275	0.85	1.32	1.81	2.42	2.77	2.96	3.02
300	0.81	1.26	1.73	2.31	2.65	2.83	2.89
325	0.78	1.21	1.67	2.22	2.55	2.72	2.78
350	0.75	1.17	1.61	2.14	2.45	2.62	2.67
400	0.70	1.09	1.50	2.00	2.29	2.45	2.50
450	0.66	1.03	1.42	1.89	2.16	2.31	2.36
500	0.63	0.98	1.34	1.79	2.05	2.19	2.24
800	0.50	0.77	1.06	1.42	1.62	1.73	1.77

1 $SE = \frac{p\,(100-p)}{n-1}$

APPENDIX D

Questionnaires